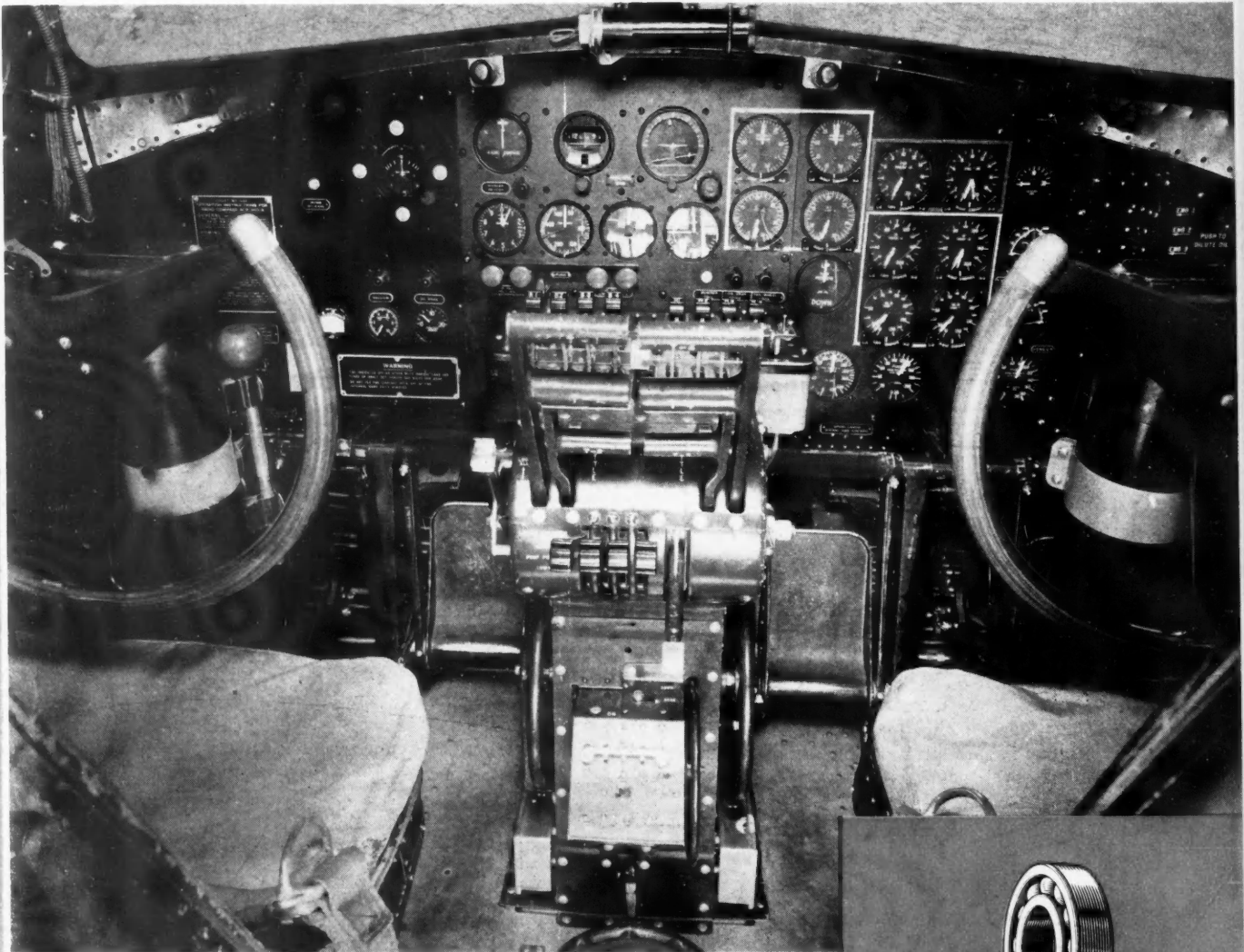


AUTOMOTIVE *and Aviation* INDUSTRIES

AUGUST 1, 1943



OFFICE of a Boeing Fortress — In flight, the clocklike dials are watched, closely, by the pilots. For on the accurate functioning of these "clocks" may depend the lives of the bomber's crew. This vital accuracy, in turn, is largely due to one mechanism: Ball bearings! NEW DEPARTURE ball bearings, by the *tens of millions*, are used in ships, tanks, planes, guns, trucks. They are being manufactured on a round-the-clock schedule, in numbers which would have appeared *impossible* . . . before Pearl Harbor.

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New Departure
BALL BEARINGS
FOR VICTORY

Cutting oil *News* letter

Practical suggestions from the field on how cutting oils and coolants are being used by midwest machine operators to lick tough wartime jobs.

AUGUST, 1943

Wisconsin shop, working beads on 20 mm. casings, lengthens tool life 80%

IN TURNING the beads on 20 mm. steel cartridge casings (1025 steel, 80 Rockwell hardness) using high speed moly tools, a Wisconsin shop found that the finish secured with soluble oil was not up to par and tool life was too short. Use of Thio Cutting Oil gave a swell finish, virtually eliminated rejects, increased tool life 80%.

How electrolysis was licked. In their efforts to keep going full tilt many shops bump into new and unexpected maintenance problems. A wire manufacturer in Indiana, for example, found that in using a high grade cup grease for bearing lubrication, some electrolytic action was encountered. This action was probably abetted by the small water content of that type of lubricant. A change to Stanodrip No. 229 solved this problem.

Can bolt threads be beautiful? Yes, say operators of an Illinois machine shop. Since they started using Acme Cutting Oil No. 110 on their bolt threading machines, the work is turned out faster, with better die life and a much cleaner thread finish.



Perhaps he has answers to your questions

Remember that a Standard cutting oil specialist has detailed information on many cutting problems, both from his own field experience and from data relayed to him by the Standard Oil Technical Department. He has, or can probably get, the answers to any cutting oil or coolant problem you are facing in your shop. For the name of the nearest Engineer, contact any Standard Oil Company (Indiana) office, or 910 S. Michigan Ave., Chicago, Ill. In Nebraska, address any Standard Oil Company of Nebraska office.

News of a cold nosing compound. We might as well tell you right off the bat this is no dog story. It's about a shop in Kansas City that was using ordinary cold nosing compound cut back with engine oil for work on 75 mm. projectiles. And it gave them these two operating headaches: 1. Difficulty in getting proper consistency; 2. Drawing ability wasn't what it should be. Now they use a Standard Oil lubricant especially adaptable for the service and "everything is jake," say the operators.

Batch filtering stops thread burning. A Ft. Wayne shop reports that batch fil-

tering of thread grinding oil on Ex-cello grinders every 4 or 5 days did away with bothersome smoking and burning of the threads in grinding a special type of stainless steel.



Suggestion for stopping tool chatter. It seems that a new "film" star has come to light. A Minneapolis shop found the answer to the tough problem of maintaining a film on ways and guides of machine tools with Stanalex No. 31. According to the report, this Stanalex film ended chatter and vibration of the carriage, and resulted in better finish on the work, even when under heavy loads using soluble oil as the cutting medium.

How stainless steel bushings were kept from turning blue. An automotive plant up in Michigan formerly used soluble oil for turning main and "con" rod bearings of truck engine crank shafts. Anxious to step up its production and better the tool life, this shop made some tests with Stanicut 107 BC. Applied in larger quantities than the soluble oil, the Stanicut cooled the work, and also made the tools last longer. . . . Then, the same oil was used successfully for turning, reaming and drilling thin-walled stainless steel bushings, which formerly tended to turn blue.

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AUTOMOTIVE and Aviation INDUSTRIES

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CONTENTS

Borings and Turnings Boost Scrap Metal Tonnage. <i>By W. C. Hirsch</i>	17
Canadian Built Military Vehicles	19
Thompson Aircraft Products Plant. <i>By Joseph Geschelin</i>	20
Convair Patrol Flying Boat for Anti Submarine Duty	26
Short Cuts	28
Mass Assembly Methods Adapted by Ford Engineers to Army 3-Ton Transport Gliders	30
AC Engineers Use Automotive Methods to Speed Automatic Pilot Production. <i>By Joseph Geschelin</i>	34
Producer Gas for Motor Transport (Part One). <i>By E. A. Allcut</i>	38
Chrysler Diesel Engines	42
New Production Equipment	43
German BMW 801 Engine	44
New Products for Aircraft	45
New Products	48
News of the Industry	50
Calendar of Coming Events	58
Advertisers' Index	148

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August 1, 1943

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4 Young Presents ADVANCEMENTS

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WAR HEADS for TIN FISH

REDY to be loaded with explosives, these war heads of giant, one-ton aircraft torpedoes are getting a final inspection. Producing the surface finish shown in the photo, as well as the more than 5,000 component parts of a completed torpedo, requires top performance from machine tools and cutters.

In the precision machining not only of torpedo parts but of millions of bullets, shells, guns, tanks and planes, war plants everywhere are assured of faster output and increased cutting-tool life, by using *Texaco Cutting Oils*.

Texaco Sultex, Transultex and Clear-tex Cutting Oils lubricate the tools,

carry away the heat and prevent chip welding, assuring improved surface finish, and maximum output per tool grind.

So effective have Texaco lubricants proved that they are definitely preferred in many important fields, a few of which are listed in the panel.

A Texaco Engineer specializing in cutting coolants will gladly cooperate in the selection of the most suitable lubricants for your equipment. Just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

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TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



IN THIS ISSUE

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 89 August 1, 1943 Number 3

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

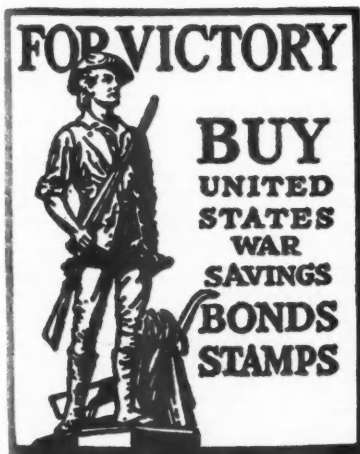
Enemy Patents \$15 Each

In view of the steadily growing demand for licenses under patents seized from enemy owners, Alien Property Custodian Leo T. Crowley has announced liberalized terms for the issuance of licenses to American business by his office.

Beginning August 1, 1943, the fee for obtaining a license to use enemy owned patents held by the Alien Property Custodian will be a flat \$15 for each patent. Hitherto, licenses have been issued for a fee of \$50 for a single patent plus \$5 for each related patent included in the same license.

The new arrangement, Mr. Crowley said, will make it easier for small manufacturers to put single patents promptly to work. It also will more equitably compensate the APC for work involved in searching out contractual agreements that already exist on specific patents.

Information concerning the 40,000 patents and patent applications now held by the Alien Property Custodian can be obtained by addressing the Office of Alien Property Custodian, Field Building, Chicago, Ill.



Borings and Turnings Boost Scrap Metal Tonnage 17

What importance this type of scrap has attained since the country has gone on an "all out for war" basis is almost beyond the comprehension of many. Perhaps you will find some surprises in this article. You will at least get a lot of information.

Thompson Aircraft Products Plant 20

Coming up for special acclaim in the war program is the Thompson Aircraft Products Co. With all of the industry exerting their utmost to produce aircraft engines that are doing more and better work than ever aircraft engines have been known to do before, the big part that this organization has played in the war effort is particularly outstanding.

Convair Patrol Flying Boat 26

This is said to be the fastest plane in the world of this type. It is a high wing monoplane, has a cruising speed in excess of 160 mph and is to be made in quantity for the U. S. Navy. It is fully described and illustrated in the article starting on page 26.

Mass Assembly Methods Used on 3-Ton Gliders 30

Gliders are more and more coming to the front in this "different from all other" war. They are taking a new place in each new report we get on the home front. Likewise they are settling into their proper place in the mass assembly scheme of production. There are some quirks that have come into being in the process that you should know about.

Automotive Methods Speed Automatic Pilot Production 34

Here is a story of accomplishments at the AC Spark Plug plant that you should put on your "must read" list. Here is a production job with tolerances so low that they are almost negligible. Accuracy with a high volume of output is really something to read about.



68 MEMBERS in this Family

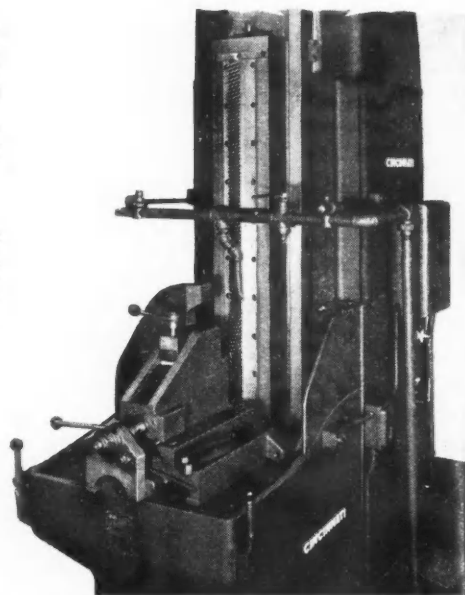
...TEAM UP FOR RAPID PRODUCTION

HAVING standardized their sizes and types of cutting tools for lathes, planers and shapers, a manufacturer of these tools found that he still had 68 different items. Since all the tool shanks required a machining operation to prepare a suitable offset on which is brazed an insert of hard cutting material, they presented quite a problem in the economical and rapid production of comparatively small quantities.

The whole family—all 68 of them—were parked on the door-step of the CINCINNATI Engineering Service Department. Being experienced in handling large families, the CINCINNATI engineers noticed that all parts had a few common characteristics which might serve as a starting point in retooling them.

To make a long story short, they designed fixtures and tools for *broaching* these cutter shanks, using only one fixture with interchangeable details to accommodate all the parts, a few of which are shown above with the fixture details. The operation—broach notch—requires two cuts in most cases because some are as much as $\frac{3}{8}$ " deep. The complete job is handled on a CINCINNATI No. 10-66 Single Ram Vertical Hydro-Broach Machine with receding table.

Perhaps our Service Engineers can be of help in recommending more economical methods of machining those families of parts which may be prevalent in your own shop. Your inquiries will receive a careful analysis.



● Close-up of CINCINNATI No. 10-66 Single Ram Vertical Hydro-Broach Machine, showing basic tooling for broaching 68 different tool shanks. Complete details on these efficient single ram machines may be obtained by writing for specification catalog No. M-886.

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, OHIO, U.S.A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES...SURFACE BROACHING MACHINES...CUTTER SHARPENING MACHINES

Borings and Turnings



Boost Scrap Metal Tonnage

By W. C. Hirsch

SCRAP metal was a problem in World War I, but it's a much bigger problem today, one of the causes being the greater importance of aviation in the present conflict. Many airplane parts are made of costly alloys, some of which are in critically light supply, and an important part of the scrap obtained in the fabricating of these parts, as well as in the shaping of parts for automotive equipment of ground ordnance, such as tanks and jeeps, consists of turnings and borings. In this form scrap is difficult to keep properly segregated and requires processing before it can be melted for re-use, so that as little as possible goes up in air. Each alloy calls for special metallurgical treatment and to attain the utmost in recovery, not only the character of the contained metals, but also the percentage in a given batch of scrap must be taken into consideration. Out of the experiences, both blunders and successes, there is now being developed a standard procedure for regaining the possible maximum of each of an alloy's components, a metallurgical set-up that differs in many respects from that in vogue in the reverse process of combin-

ing a number of primary metals into efficient alloys.

Right here it should be pointed out that the scrap problem in the last war, and to some extent in the present one, revolved around getting a sufficient tonnage of carbon steel scrap so as to conserve as much iron ore and coke as possible and to supply open-hearth furnaces, which are designed to require a certain percentage of scrap in their melts (usually figured at 50 per cent) with the necessary raw material. The problem of obtaining adequate tonnages of disused iron and steel from railroads, farms, homes, industries, automobile graveyards, etc., while at times a headache to steel mills and foundries, is one entirely distinct from that of the efficient re-utilization of the scrap which a plant produces in the course of its operations in machining, casting, etc. Like so many terms that have crept into our industrial and commercial vocabulary, the word *scrap* lacks definitiveness, being frequently associated with junk, although it means nothing more than a small piece of anything. Just why a piece of discarded cast iron, which loses very little of its value or weight in remelting, should be looked upon as a pariah by the side of virgin foundry iron, is difficult to understand.

(Turn to next page, please)

After all, iron is iron, whether in the form of scrap or straight from the furnace. Some of the large copper products manufacturers instituted a much needed reform shortly after the last war, when they notified their customers that, what up to then had been scrap copper and disposed of to a waste material dealer, would be taken back by them, if obtained from their products and properly segregated. Certain it is that cuttings, clippings, turnings, etc., resulting from fabricating operations, are more properly classifiable as a re-usable by-product than as waste material.

What importance borings and turnings have attained since American industry, especially automobile manufacturers, went on an all-out war basis may be gleaned from a recent report of the Scrap Iron & Steel Institute, which stated that borings and turnings in 1943 may amount to as much as 5,000,000 tons of carbon steels and 2,000,000 tons of alloy steels. Last year they accounted for 2,900,000 tons of the scrap supply. The Business Press Industrial Scrap Committee, which is doing valuable work in promoting a program to facilitate the movement of turnings and borings and scrap in general, lists as one of the major points in the WPB Industrial Salvage Branch program that of encouragement of producers to install crushing equipment for processing this type of scrap, where it is warranted. Arrangements with the Reconstruction Finance Corp. will permit the financing of crushers, where it is felt that conditions warrant it. Such crushers will add materially to the free flow of scrap back to usefulness.

Conservation and segregation of the different kinds of alloy scrap is merely a matter of common sense personnel and plant management. Now that this task has been made obligatory by the War Production Board authorities, it should be easier to obtain general compliance. Here is the way the system works at the Eclipse-Pioneer Division plant of the Bendix Aviation Corp. When the plant set-up man assigns operators to cutting, drilling or boring machines at the beginning of a work shift, he posts on each machine a printed card, showing the kind of metal or type of alloy being worked. There are six groups: Plain carbon steels; steel containing 1 to 3 per cent nickel; steel containing 3 to 5 per cent nickel; molybdenum steel; chrome-vanadium steels; and "stainless" steels. In each group from two to twelve grades call for separate listing. Forms are provided for four grades of aluminum, 30 types of brass, bronze and plain copper and one type of magnesium. Operators must keep the cards posted on their machines, until each job is completed to assure scrap identification.

The set-up man sees that machines are cleaned of one type of turnings or other scrap before there is a change-over to a job that calls for another metal or alloy. The scrap-filled collection trucks, each with its contents-identifying card, are then whisked away to the central salvage depot, housed in its own building. There the turnings are dumped into a hopper and lifted by a skip-hoist to a sorting table, where butt-ends or rough parts are separated by hand. A crusher pulverizes the accumulation into shoveling chips. Crushing is the first step in oil separation and conservation, which is completed in a container equipped

with a centrifugal extractor. The clean metal turnings travel by air pressure to steel hoppers that convey them to trucks, which then haul them to smelters where they emerge, after processing, as usable metal. Bendix engineers have given freely of their counsel and suggestions to other war material plants confronted with salvage problems.

In normal times, profitability determines a plant's scrap reclamation set-up. Obviously, General Electric, with a yield last year of around 160,000 tons of iron, steel, and alloy steel scrap; 31,200,000 lb of copper, copper alloy and brass scrap; 22,700,000 lb of lead; 4,300,000 lb of aluminum and 2,500,000 lb of zinc scrap, can maintain a more elaborate

scrap organization and equipment than could a smaller enterprise. In the present war emergency, however, there is urgent need for every ounce of recoverable metals, and costs or profit count for little. Bringing this material back into useful service with as little delay as possible calls for more thorough segregation of the various classes of scrap at the source of origin. Whether in the case of non-ferrous metals segregating in war material fabricating plants can go to the length of replacing the metallurgical laboratories of secondary smelters is a moot point. A long list of scrap varieties, set up by the secondary metals trade, was recently published to point out to scrap producers the necessity of extraordinary care in the separation and segregation of scrap. It is obvious that scrap resulting from an alloy with a copper content of 40 per cent should be kept separate from one with a copper content of only 10 per cent, but some of the differences between this or that alloy scrap description are based on commercial rather than metallurgical considerations, and the war effort will hardly be helped by making this job of scrap segregation too complicated an affair.

To conserve all the nickel possible and to let none of it be lost through failure to recognize its presence in scrap, a nickel spot test kit for the non-destructive

(Turn to page 136, please)

Total Iron and Steel Scrap at Foundries and Steel Plants in United States

(Net Tons)

Jan. 1, 1940	5,310,000
Jan. 1, 1941	5,472,000
Jan. 1, 1942	3,726,000
Mar. 1, 1942	3,455,000
May 1, 1942	3,683,000
Oct. 1, 1942	4,993,000
Jan. 1, 1943	6,316,000
Mar. 1, 1943	6,209,000
May 1, 1943	6,250,000



(Left) An armored scout car followed a heavy duty personnel carrier.

(Right) In this photo are shown some of the 50 military vehicles that took part recently in a demonstration of war equipment being built in Canada. At that time Canada's half-millionth unit of motorized equipment, a battery charger truck made at Oshawa, was presented to government officials. In order from the front of the line in the photo is an armored scout car, a Fox armored combat car, Bren gun carrier, personnel carrier, a battery charger truck, etc. Ford, General Motors and Chrysler plants are turning out the battery charger trucks.



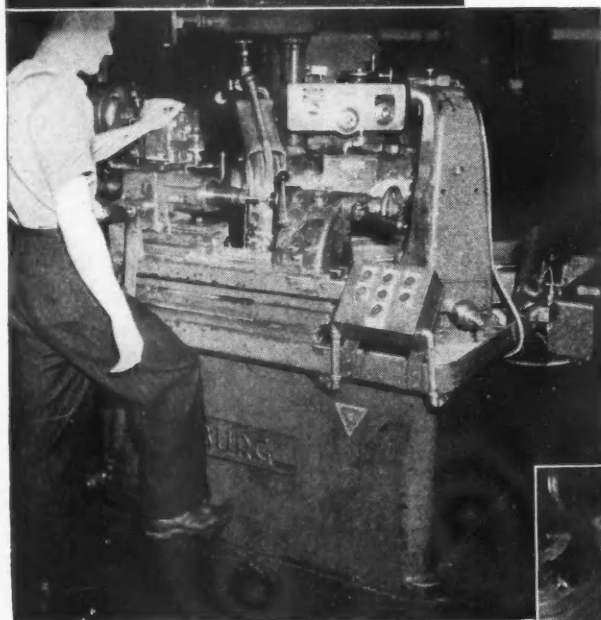
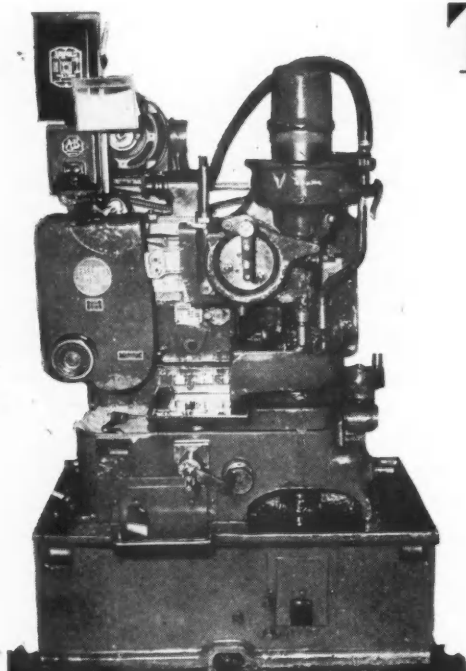
(Above) A Fox armored combat car with a revolving turret.

Canadian-built Military Vehicles

(Below) A Chevrolet 3-ton field artillery gun tractor is shown here towing a trailer and a 25-pounder gun. Tractors of this type are being built at the General Motors and Ford plants in Canada. They have a wheelbase of 101 in. and are equipped with a four-wheel drive, four-speed transmission, and two-speed transfer case. A tire pump is driven from the transmission. A winch, which is mounted on the chassis frame below the body floor, is operated from a power take-off on the transfer case. Front axle universal joints are of the 6 in. Bendix or Rzeppa constant velocity type. Cross country radius of action is 200 miles and on the highway 350 miles.



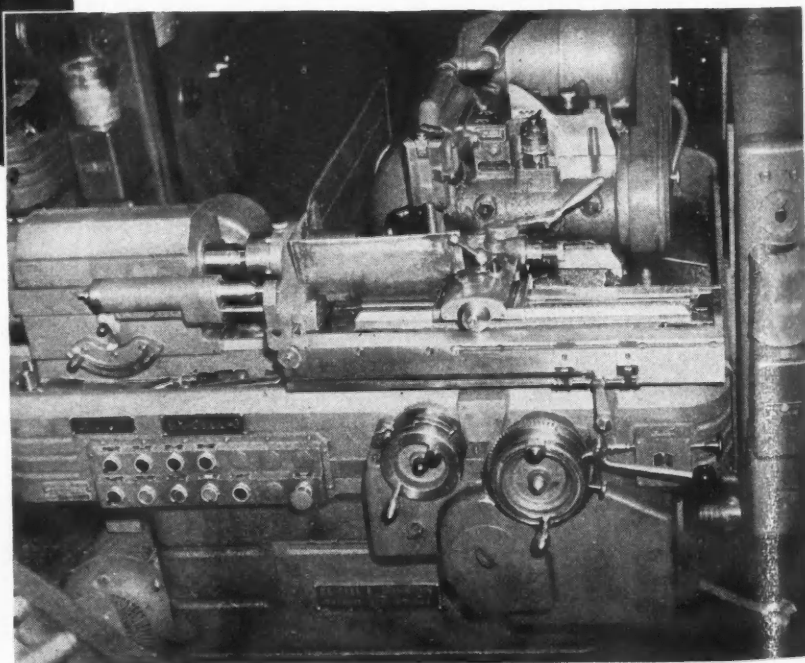
Thompson Aircraft



(Top) Fellows gear shapers of several types are used for cutting gears and internal splines—the operation shown here.

(Center) Fitchburg angular head grinder is set up here for finishing valves.

(Right) One of the Ex-Cell-O precision thread grinders that has been converted for form-grinding of various parts such as valve stems.



STARTLING as it may sound, military airplane engines produce more horsepower from one cylinder than is developed by the average passenger car engine. It is not unusual today to find production airplane engines capable of delivering as much as 140 hp per cylinder. That this achievement can be realized in mass production may be credited to the marvelous development program throughout the airplane industry, and in particular, to the great strides made by the technical organizations who contribute parts and accessories for engines that fly.

Consider the accomplishments of Thompson Aircraft Products Co., whose new plant offers one of the finest examples of mass production of engine valves and an amazing variety of aircraft engine parts. Major contribution of the TAPCO organization is the hollow sodium-cooled exhaust valve which is responsible for a share of the credit for present-day high performance, high output engines. Not only does the sodium-cooled valve aid in the development of maximum power; it contributes to reliability and long life as well.

TAPCO is producing upwards of 75 different types of engine valves, about 1000 different kinds of aircraft engine parts in the new plant. Hollow-head and hollow-stem exhaust valves and solid intake valves are made from materials that are extremely difficult to work. The exhaust valves, in particular, require some 300 different operations, pose one of the most

Products Plant

By Joseph Geschelin

intricate manufacturing problems to be found anywhere in the industry.

In the parts field, TAPCO is one of the principal suppliers of numerous hardened and ground parts such as—valve seat inserts, piston pins, bushings, nuts, rings, rollers, carriers, bolt, flyweights, shafts, sleeves, valve spring washers, etc. Included in this category are a number of types of stretch bolts, said to be the most highly stressed elements of an airplane engine.

The TAPCO plant offers a marked example of modernity in equipment and planning and specialized techniques adapted to the manufacture of the variety of products mentioned above. Original schedules called for reaching peak production at the end of the thirteenth month of operations. The peak schedule was actually reached in the fifth month of operation, and had been doubled by the eighth month.

Generally speaking, the plant facilities have been so husbanded as to achieve the maximum results from each piece of equipment. For example, each part has been studied by the engineering department to the end that it may be produced most efficiently. Those parts that are required in large volume and in continuous production have been segregated in self-contained departments in the interest of straight line manufacturing methods. Parts required in smaller volume have been planned for job-lot production and are routed over the general purpose equipment.

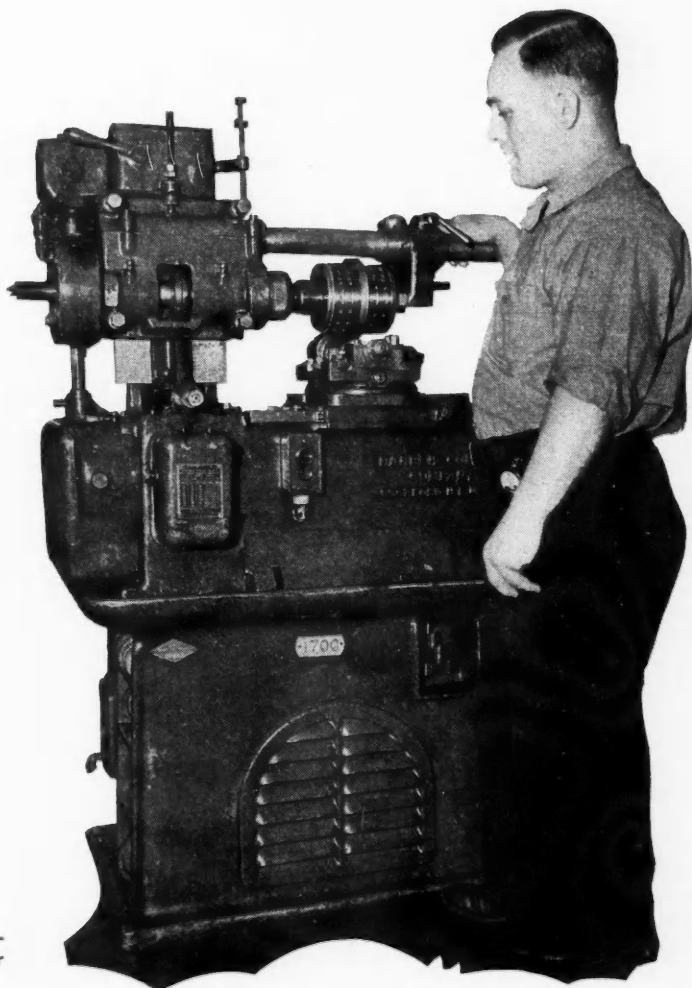
Following this pattern, it is found that many types of valves are made in self-contained departments. The hollow-head, hollow-stem sodium-cooled valve is so important of itself and required in such large volume that its manu-

facture has been centralized in a separate building, provided with all of the specialized equipment and service facilities such as a forge shop, heat treating, sodium processing department, etc.

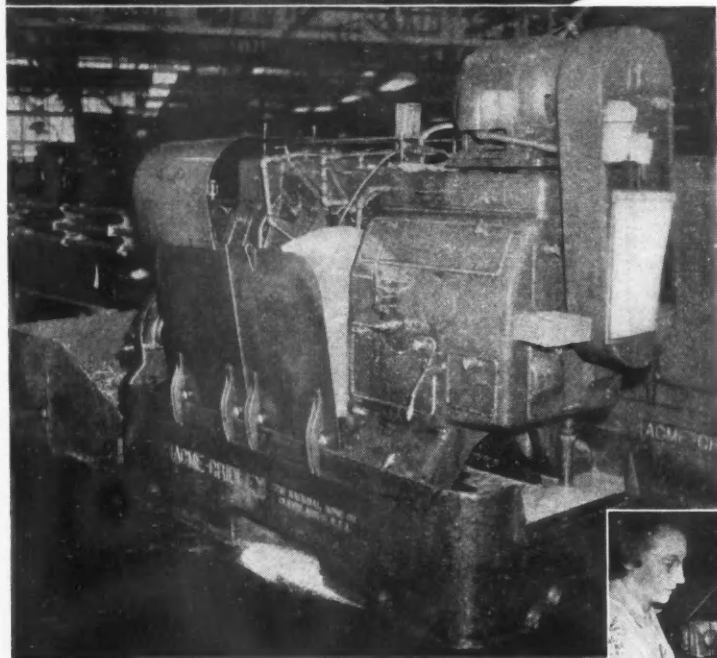
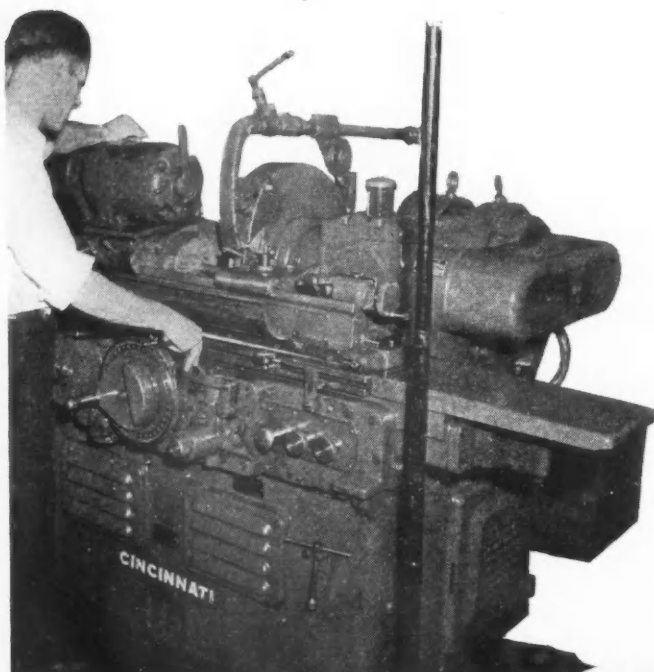
Production planning is based on an exceptionally high plane. Manufacturing equipment has been chosen deliberately to utilize, in the main, standard items of high production machinery of familiar types so as to make for the maximum of FLEXIBILITY. In essence, this foresightedness means that the organization is not frozen as to product design of methods, thus is free to accommodate changes in accordance with the fluidity of the war. On the other hand, there are some items of equipment which are decidedly of single purpose type, designed to handle mass production operations of specialized nature. A significant example of this is the rotary type American surface broaching machine used for cutting the hexagon head

*This is the Eighty-fourth
in the series of monthly
production features*

This Barber-Colman hobbing machine is one of several types of gear cutting equipment in this plant.

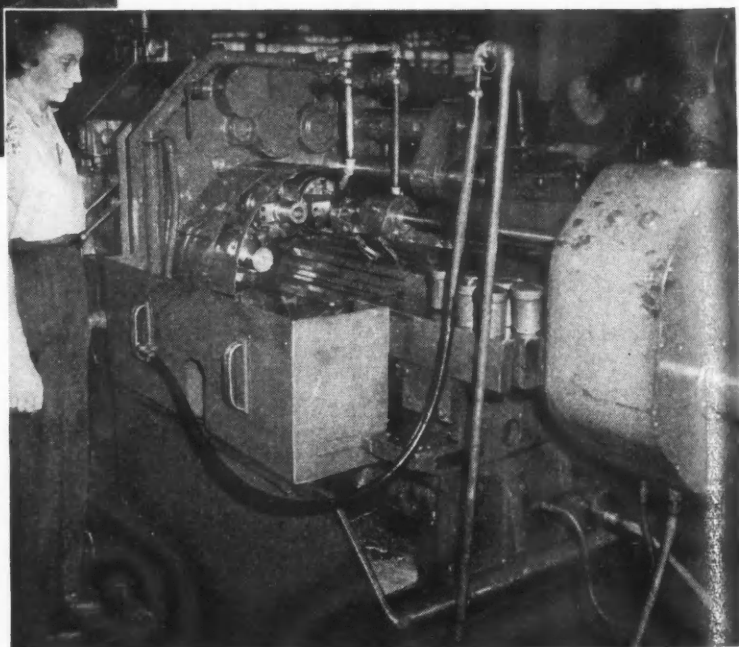


One of the Cincinnati Filmatic plain grinders, typical of grinding equipment.



(Above) New National Acme-Gridley automatics in the screw machine department, fitted with built-in chip conveyors. These are part of a battery of 80 such machines in this plant.

(Right) Close-up of work station of a New Britain-Gridley automatic, one of many such machines in the screw machine department.



on studs. This machine has a large circular indexing table with a multiplicity of chucking stations to hold the studs. It has three principal broaching stations—each one with one pair of broaches—so as to cut two flats at a time. The studs are indexed around, automatically, at each of the three broaching stations.

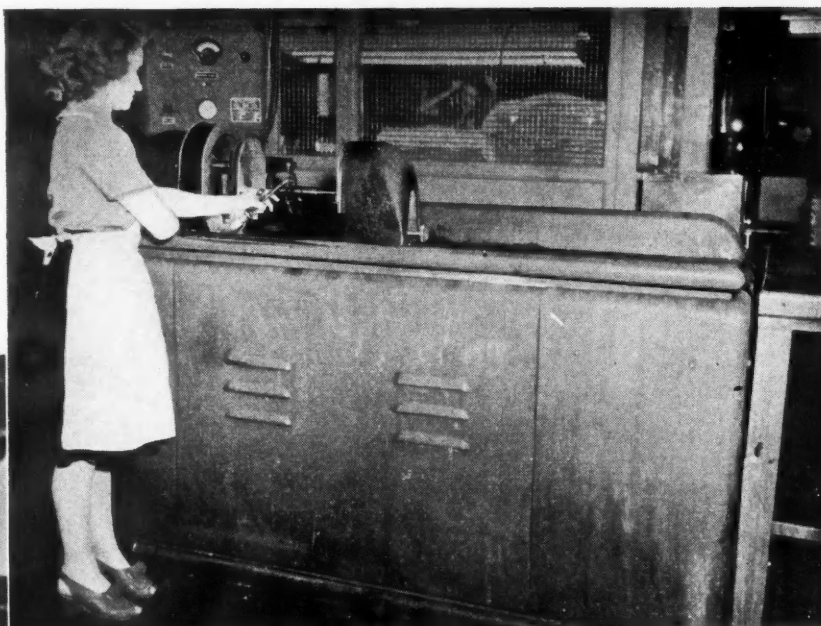
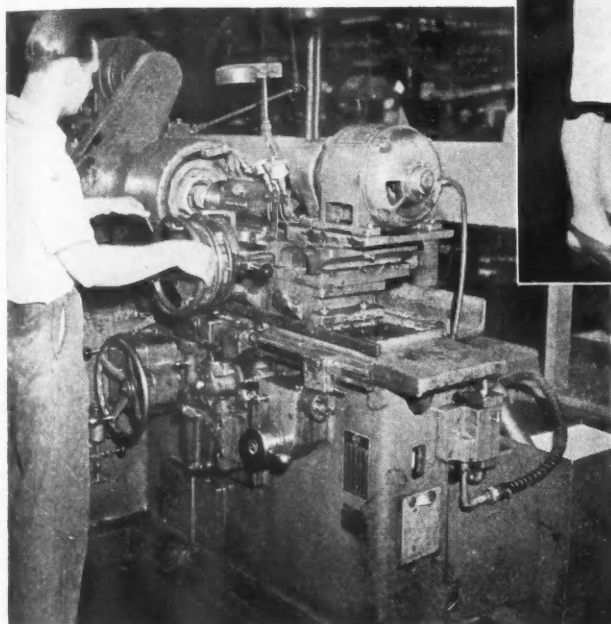
Even the standard equipment can be tooled for specialized operations. As an example, consider the National Acme-Gridley automatic chucking machines. When tooled for valve machining, these are provided with an automatic loading station so arranged as to load a valve into the chuck at the proper time. Upon completion of the operation, the valve is automatically ejected into a magazine hopper. Another example is the use of magazine feed on Brown & Sharpe automatics in the production of small screw machine parts.

In keeping with modern practice, the plant has been equipped with Turnbull bus-duct for power wiring, thus centralizing the distribution of power, and making it possible to move machinery at will and without loss of time; also promoting good housekeeping. The introduction of fluorescent lighting throughout the plant makes for better seeing and is a major element in promoting high standards of quality.

Materials handling has been given careful attention. Most of the hauling is done with electric industrial trucks of various types, including special high lift units for tiering. The plant is threaded overhead by a system of cranes for other types of materials handling operations, particularly the movement of heavy loads. Gravity roller conveyors are employed for connecting machine lines. An overhead monorail conveyor system is projected

(Right) Magnaflux inspection machines are provided in every department as well as in the final inspection.

(Below) Bores in many types of parts are finish-ground in Heald internal grinders.



for the new sodium-cooled valve plant. Many of the machines, particularly the automatic screw machines, are provided with built-in chip conveyors and the chips, in turn, are transported to the chip disposal plant for crushing and oil extraction. The crushed chips are then lifted by means of a bucket elevator into gravity discharge bins located over a railroad track for direct discharge into railroad cars.

Owing to the variety of products and intricacy of individual routings, it is not feasible to picture this operation save in generalized terms. One approach is to note the general character of the manufacturing equipment. This will be supplemented with a brief comment on some of the steps in the manufacture of a few typical parts.

Among the many items of equipment found in this plant are the following—National Acme-Gridley, and New Britain-Gridley automatics; Conomatics of various sizes, including a battery of 3½ in. machines; Cincinnati Filmatic grinders, Cincinnati Centerless grinders, and Cincinnati Centerless grinders specially fitted for superfinishing; Sundstrand lathes; Ex-Cell-O thread grinders; Ex-Cell-O precision boring machines; J. & L. precision thread grinders; Fitchburg angular head grinders; Heald internal grinders and Heald Bore-Matics; Fellows gear shapers for cutting internal splines; Barber-Colman hobbing machines for external splines; Hanchett surface grinders; Arter surface grinders; and others.

Among other types of technical equipment are—Surface Combustion furnaces, Electric Furnace Co. batch-type nitriding furnaces, and Leeds & Northrup Homo nitriding furnaces in the heat treating department; American Wheelabrator equipment for sand blasting; etc.

The plant boasts an outstanding electroplating department with equipment for plating cadmium, copper, tin, chromium, nickel. Prize exhibit in this department is the F. B. Stevens automatic plating machine, of the type so widely used in the automotive industry in peacetime. It is currently set up for plating cadmium. A feature of the plating room is the elaborate exhaust ventilating system with its intricate pattern of ducts venting every piece of equipment and doing the job so well that the atmosphere is clean and pure, making for exceptionally pleasant working conditions.

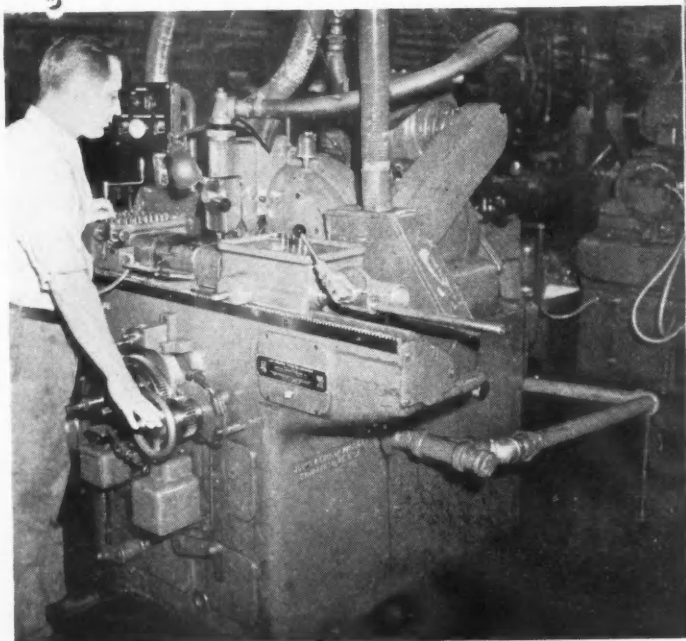
This principle of exhaust provision is extended to all operations in the plant where dust or fumes are associated with the task, as in the case of grinders, polishing machines, etc. All such equipment is provided with exhaust ducts which are directly connected to individual units of Industrial Sheet Metal Co., Hydro-Whirl cabinets.

Wherever there is exceptional fire hazard as in the case of the heat treat and in the sodium room of the exhaust valve department, full protection is afforded by a portable Cardox Transitruck unit, charged with liquid CO₂ under pressure.

Consider now the steps in the manufacture of several parts selected at random. It may be noted at this point that TAPCO production involves the highest grade of dimensional tolerance control as well as fineness of surface finish. Many dimensions are specified to the tenth of a thousandth of an inch; many of the surfaces must be finished to as low as four micro-inches. In the control of surface finish, they employ the well-known Profilometer measuring equipment in establishing standards and in checking on production parts. In other instances, surface finish is controlled with the Brush Surface Analyzer. Needless to say,

(Right) Work station of rotary surface broaching machine made by American Broach Co. It is tooled to produce a hexagon head stud, cutting flats two at a time in each of three broaching stations

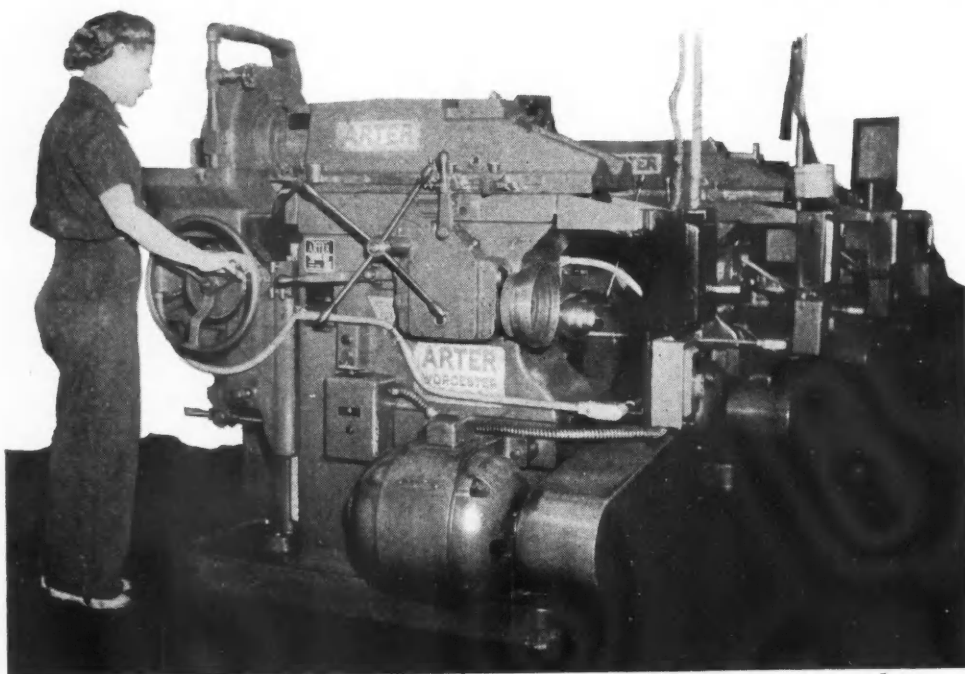
(Below) Threads for aircraft parts are cut on Jones & Lamson automatic thread grinders as shown here.



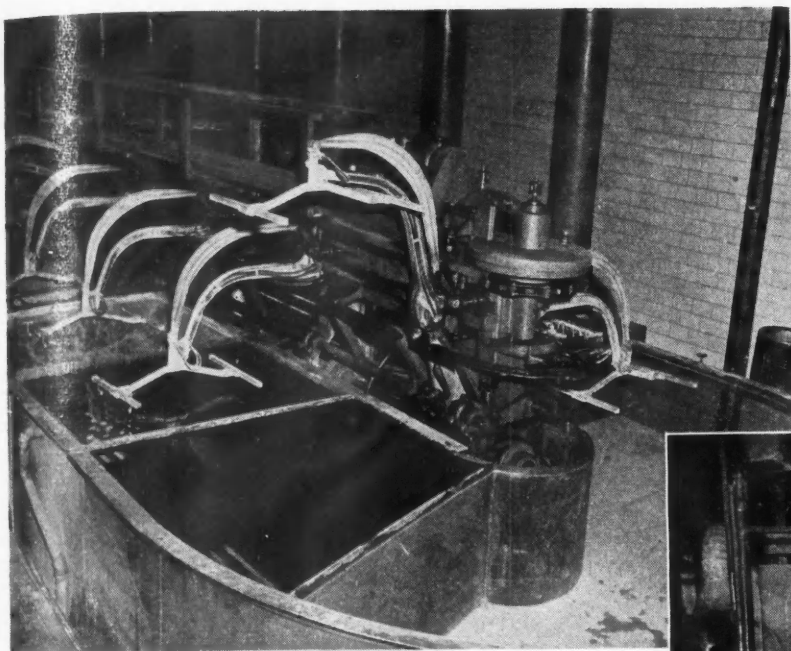
all of the parts in this plant are subject to Magnaflux inspection. To this end, various types of Magnaflux inspection equipment are found in the machine shop as well as in the inspection departments.

The intermediate blower crankcase liner is typical of the sleeve parts produced here. It is a flanged sleeve, about $7\frac{5}{8}$ in. in length, held to plus or minus 0.002 in. on the length, with stepped diameters and stepped bores. Several bores of 2.373 in. and 2.344 in. are held to plus or minus 0.0005 in. This piece is made of bar stock, rough machined on Warner & Swasey turret lathes, degreased, carburized and sand blasted. Then rough-ground on a 6 x 18 Cincinnati plain grinder, machined further on W & S turret lathes, 20 holes drilled on an Allen drill press, degreased, hardened in an Ajax salt bath

pot, drawn, sand-blasted. This is followed by a variety of steps on W & S machines, Cincinnati plain grinders, Heald internal grinders, milling of slots on Brown & Sharpe milling machines, finish-grinding operations on Cincinnati plain grinders, and Brown & Sharpe universal grinders. Finish-grinding operations are followed by breaking of corners, blending, and buffing. The work is de-

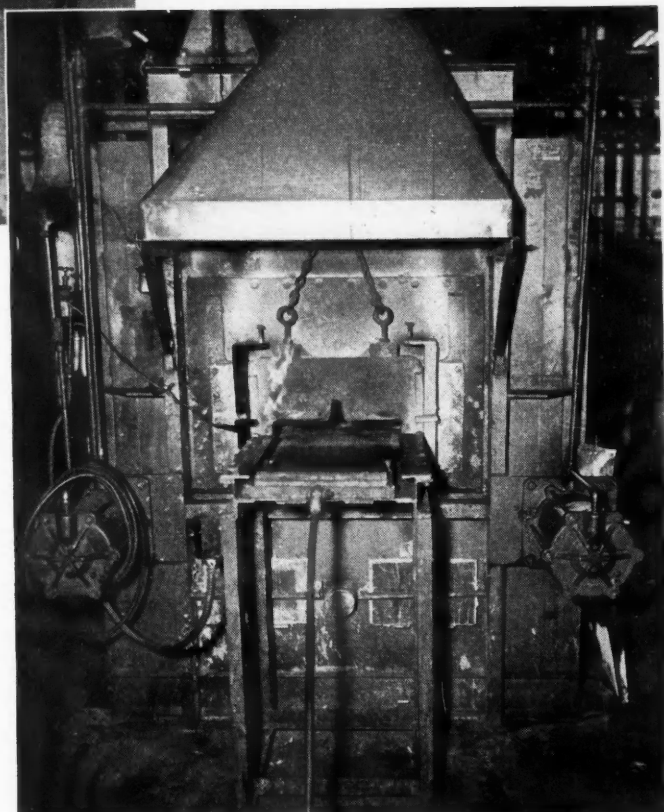


Part of a battery of Arter surface grinders in the grinding department.



(Left) One end of the Frederic B. Stevens automatic electroplating machine.

(Below) Entrance end of Surface Combustion Co. continuous heat treating furnace in the heat treating department.



greased, checked for Rockwell hardness, Magnaflux inspected.

Typical of many shafting jobs is the small electric motor shaft which is about 6-11/16 in. long. One end is precision-threaded on a J & L thread grinder to produce Class #3 thread; the other end is splined on a Barber-Colman hobber. The splines are held concentric to each other within 0.001 in. full indicator reading. The 0.4345 in. diameter at the threaded end is held to plus or minus 0.0005 in. This is a screw machine product, turned from bar stock on a 1½ in. four-spindle Conomatic. Spline end is ground on a Cincinnati plain grinder, then the splines cut on a Barber-Colman. This is followed by carburizing and hardening in Ajax salt-bath furnaces. Centers are lapped on an Ex-Cell-O center lapper, then the OD is ground in successive steps on Cincinnati plain grinders, Cincinnati centerless grinders, keyways rough- and finish-milled on B & S milling machine, thread ground on a J & L thread grinder. The spline end is copper-plated to provide a lubricated fit at assembly. Final operations are finish-grinding of bearings at both ends on Cincinnati hydraulic universal grinders, and breaking edges of chamfers on Cincinnati plain grinders. The work then is inspected and Magnafluxed.

As mentioned earlier the crankshaft stretch bolt is one of the most highly stressed parts of an airplane engine. Typical of the variety of these bolts is one without flange, 6.940 in. in length, the length being held to plus or minus 0.010 in. It is threaded at both ends, with an internal spline at one end for tightening at assembly, and is intricately formed on the interior to provide uniformity of wall cross-section. The threads are ground and held concentric and square with axis within 0.002 in. full indicator reading.

This particular piece starts as a forging, normalized and sand-blasted before machining. Turning operations are handled on a battery of W & S turret lathes,

the relief in the stem being bored on a Monarch lathe. Splines are cut on a Fellows gear shaper. Following a series of grinding operations on Cincinnati plain grinders, the threads at both ends are ground on J & L thread grinders. The pieces are inspected, Magnafluxed, then the entire outside surface is flash copper-plated and flash lead-plated, buffed to remove excess plate.

A constant production engineering development program, supplemented by suggestions made by the workers, has resulted in a steady improvement of methods and oftentimes in the creation of exceptional techniques. One of the most outstanding of these is the adaptation of J & L and Ex-Cell-O precision thread grinders for form grinding operations, possibly the first use of this equipment for such purposes. This method is employed for the shaping of seats, heads, and stem ends of valves, a single operation on the converted thread

(Turn to page 86, please)

CONSOLIDATED Vultee (Convair) Model 31, an anti-submarine patrol flying boat with a cruising speed of over 160 mph, will be produced on a quantity basis at New Orleans for the Navy. It is said to be the fastest plane of that type in the world. A high wing monoplane flying boat with two engines, twin tail and retractable wing floats, it is of all-metal construction (aluminum alloy), with fabric covered ailerons, elevators and rudders. Power is supplied by two Wright R-3350 engines, developing 2000 hp. These engines were first used on the Model 31 as the result of a desire of the Wright Aeronautical Corp. to have them actually tested under flight conditions.

Actual design work on the aircraft, financed entirely by Consolidated Vultee, began July 11, 1938. One of the original features of the airplane was the installation of the Davis airfoil, designed by David R. Davis. The time from first design to actual flight, 9 months and 25 days, established a new speed record for the design and building of a large airplane, later to be shortened to just nine months in the case of the Consolidated Liberator (B-24). In fact, one of the reasons for the short design period for the Liberator was that tail surfaces and wing plan form of the Model 31 were incorporated in the Liberator.

For the past several months, engineers have been devoting themselves to breaking down the construction of fuselage and tail into panels for assemblies and sub-assemblies. Utilizing the fabrication lessons learned in the course of producing in quantity the Liberators, the flow principle is being used. First the keel is laid, then bulkheads and floor frames are assembled, resulting in a huge skeleton. Then, all the other components are brought up for installation of panels, which include skin, stringers, frames, brackets for both interior equipment and exterior equipment, are placed. It is expected that this method of manufacture will specifically cut time in final assembly, as well as in sub-assembly, and that the man-hours consumed per unit will be unusually low.

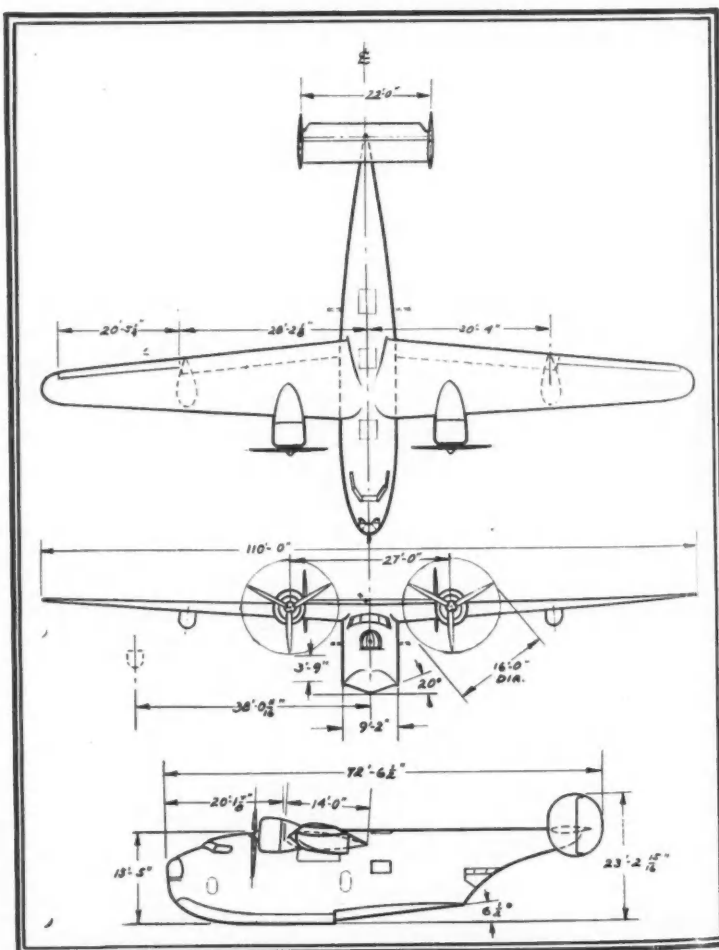
Included among those parts being broken down into panels is the flight deck which goes on in one assembly after being built up from panels. Other parts receiving the same fabrication treatment are the waist turret section, after body, tail compartment and nose compartment. The flight deck contains stations for pilot, co-pilot, radio operator and navigator.

Instruments and controls are so grouped that a flight engineer may or may not be

included in the crew. A push-pull control system, incorporating sliding rudder pedals as used on the Liberator is installed. There are an overhead hatch, astrodome, and exit hatch. Armor plate protection is provided for all personnel. Double windows are provided for the thermal anti-icing system, which will be discussed later.

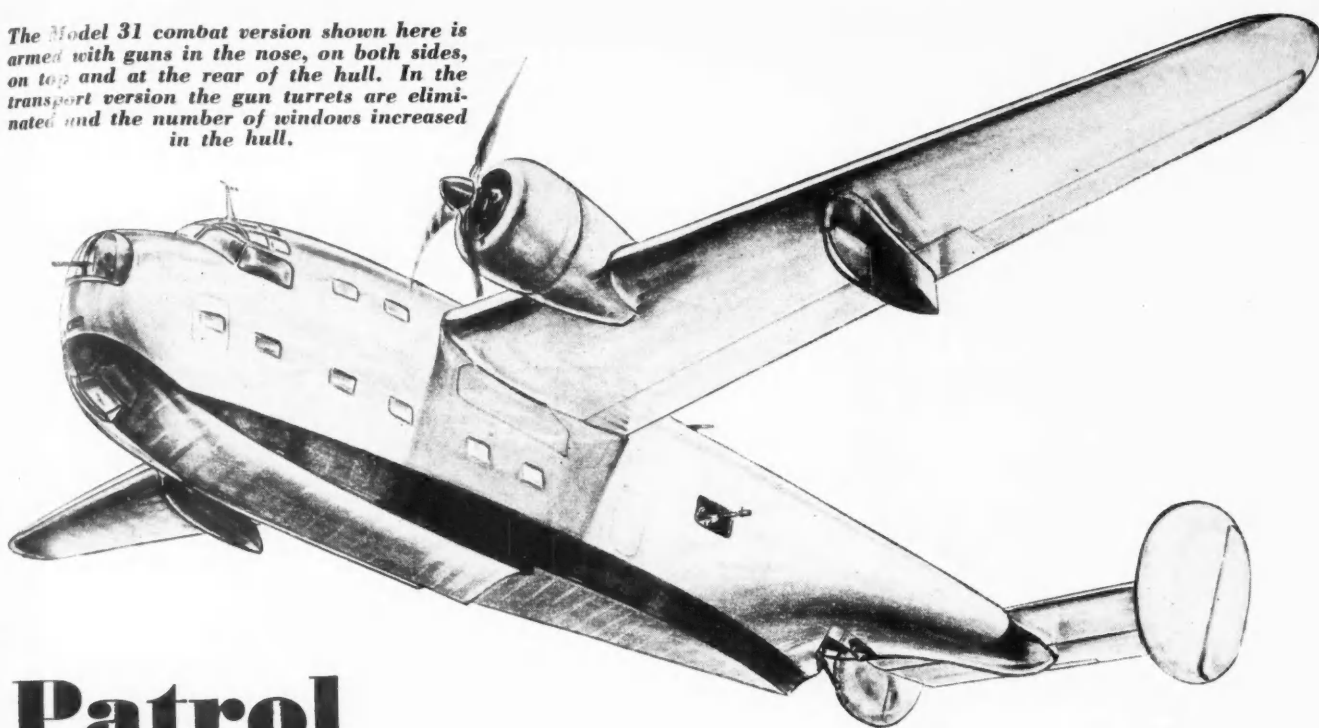
Below the flight deck, aft, are quarters containing four bunks, galley equipment, and clothes locker. Ample headroom is provided. Below the flight deck, port and forward, is the anchor compartment. Starboard is an auxiliary entrance door, mooring hatch, and a Stewart Warner auxiliary heating unit, producing 100,000 Btu.

Convair



Principal measurements of the hull, wing and empennage of the Model 31 flying boat.

The Model 31 combat version shown here is armed with guns in the nose, on both sides, on top and at the rear of the hull. In the transport version the gun turrets are eliminated and the number of windows increased in the hull.



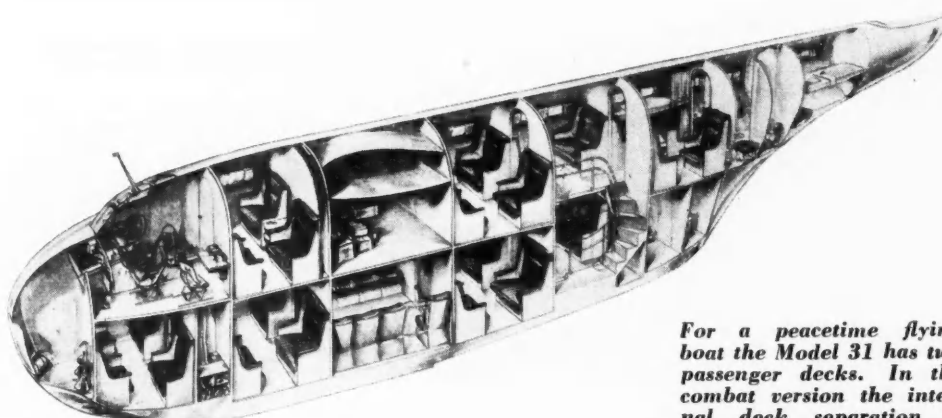
Patrol

Flying Boat for Anti-Submarine Duty

Aft of the flight deck is the depth bomb compartment. Original design provided for the opening of the hull between keel and chine for the release of bombs. The doors were equipped with water-tight hatches. Modification for the handling of depth bombs led to elimination of the doors in the hull bottom. The depth bombs are now attached to two cars or carriages running on tracks from the interior

of the hull to the under surface of the wing inboard of the engine nacelles. Operation is electrical. The depth bombs are held in ready position until released and then the carriages are retracted inside the hull. The door for closing the hull is mounted on the carriage.

In this same compartment are the entrance ladder to the flight deck, auxiliary hydraulic stand-by pump, fuel units box, with cross-over valves and other equipment, and a manual stand-by motivation system for the depth bombs. Aft of the depth bomb compartment is a compartment back of the trailing edge of the

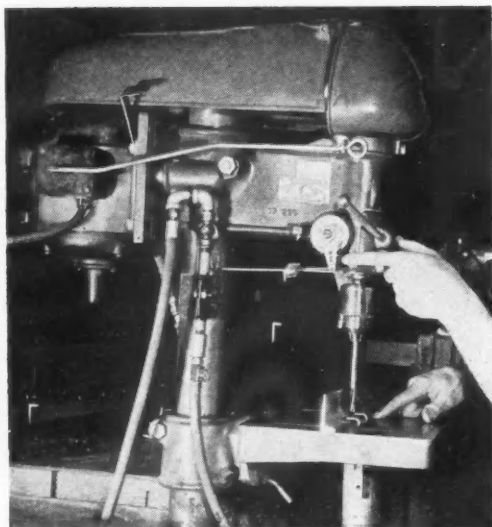


For a peacetime flying boat the Model 31 has two passenger decks. In the combat version the internal deck separation is eliminated and the space occupied by fighting equipment and supplies.

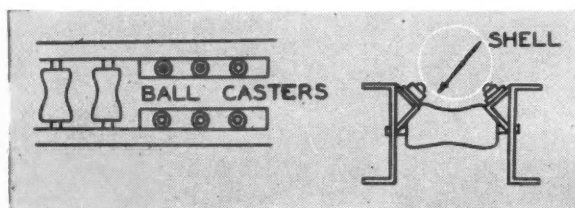
wing containing auxiliary power plant, entrance door to port and beaching door to starboard, and escape hatch providing for ejection of life raft and emergency rations. From here aft are parachute flares, sea anchor and engine warm-up fitting, which allows the plane to swing downwind. In this position the engines can be warmed to temperature and then mooring lines can be cast off by merely pressing a lever.

Thermal heat for the gunner is pulled off the thermal anti-icing system by a secondary heat exchanger. The windows are bullet-proof glass and armor also

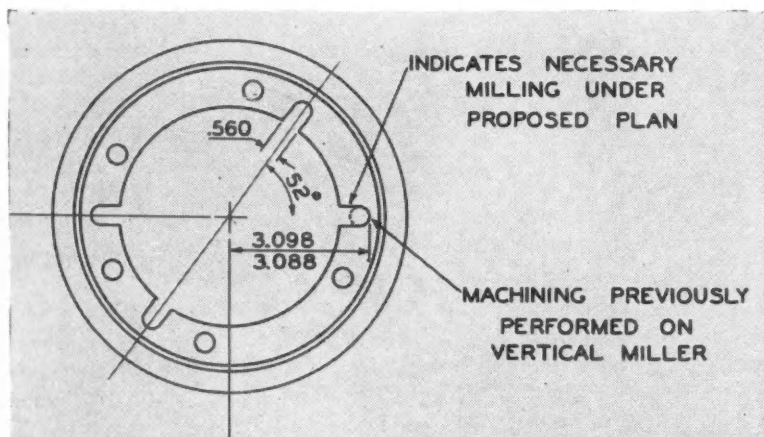
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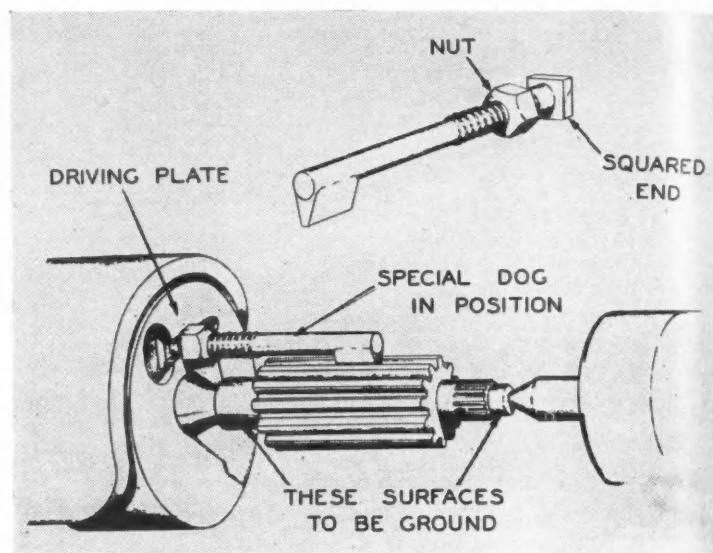
(Above) Installing an air clamp on the drill table and synchronizing its operation with the movement of the drill increased the output of angle parts at the El Segundo plant of the Douglas Aircraft Co. As the drill is lowered the mechanism automatically supplies air pressure to the cylinder which is equipped with two prongs for holding the work. Then as the drill is raised, the air pressure is released and the part can be moved to the next position for drilling.



(Above) as shown in the illustration ball casters are substituted for rollers on the conveyor line to permit the turning of a shell around its axis as well as moving it along during inspection. This device has facilitated shell inspection at the Pullman-Standard Car Mfg. Co.



Short

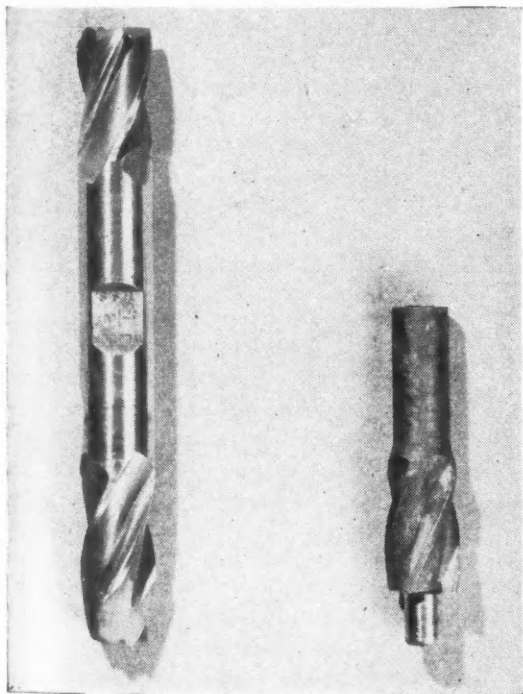


(Above) This special driving dog developed at the Aircraft Engine Division of the Packard Motor Car Co. to facilitate the grinding of gear shafts has doubled the output of those parts. When installing the dog, the squared end is inserted back of the slot in the driving plate and the nut screwed down to tighten it in place as shown in the illustration. The tang, which fits between the gear teeth, is made of bronze so as not to mar the teeth and is brazed onto the steel shank. Once this dog is mounted on the machine, gear shafts can be removed and set up for grinding without loosening it. Previously the standard type dog had to be removed and attached twice for each part.

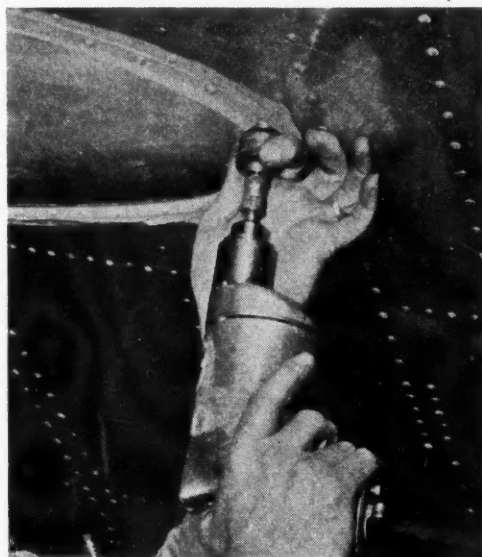
(Left) On a support-shaft center bearing it is necessary to mill four slots with a 0.560-in. end mill, 0.375 in. deep and 0.675 in. long. This is a very heavy cut for this size end mill, and the tough metal causes the mill to "walk" or "climb," with the result that the slots are crooked and do not fit the mating part. It was suggested by Robert Petering of the Wright Aeronautical Corp. in Cincinnati that four holes be drilled with a 0.500-in. drill at the center of each slot, leaving only about 0.030 in. stock on each side to be removed by the mill. This greatly relieved the strain on the mill, which now cuts a straight slot, and the life of the mill is increased 90 per cent. The milling time per unit is reduced from 40 to 6 minutes, and it takes only 2 minutes to drill the four holes.

Cuts

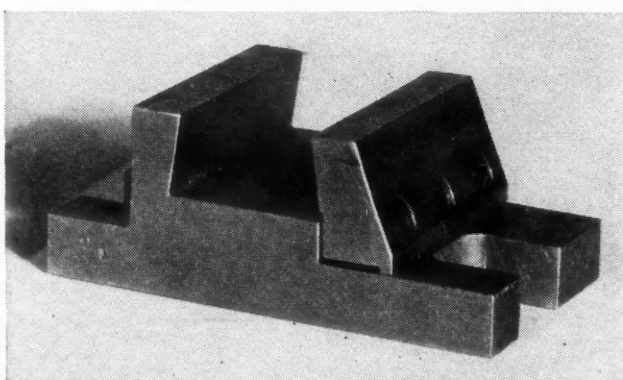
(Below) Tool conservation at the Mansfield Works of the Westinghouse Electric & Mfg. Co. includes the making of counterbores from broken double-end mills. The end mill first is annealed and then cut in half, after which each part is mounted in a lathe and a pilot machined on it. Next the counterbore is backed off and rehardened.



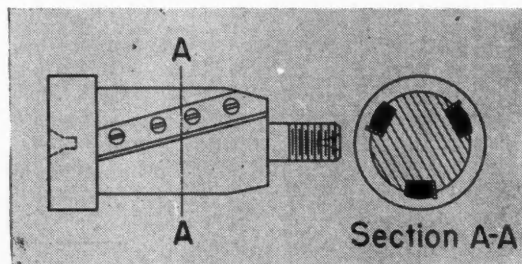
(Right) The life of solid stacking arbors for the alignment of punchings when assembling the stators of small instrument-type, electric motors for airplanes was found to be very short, owing to wear produced by pushing 0.010-in. punchings over precision-ground surfaces. The sharp edges of the silicon-steel laminations cut into the arbors, which soon destroyed the aligning properties of the latter. Further difficulties arose from the fact that the punchings are stacked helically, with an 8-deg. helix angle. This called for three 0.025-in. lands extending into the slots, which had to be machined on the arbor. As these lands wore thin, an uneven, saw-edged slot often resulted. F. W. Smith, one of General Electric's tool designers, found that by machining the body of the arbor undersize and milling $\frac{3}{8}$ -in. wide slots in it, spring-steel lands could be used. These are held in place by keys secured to the arbor by flathead screws and ground to the correct diameter when assembled. When wear becomes apparent, these lands and keys can be replaced by spares.



(Above) A piece of file cut in circular shape and brazed on a countersink, then placed in an electric drill, has eliminated hand filing of the blind-type rivets used on exhaust fairings of bomber wings. This method has been adopted at the main aircraft plant of the Fisher Body Division, General Motors.



(Above) An improvement in a die holder for split dies was suggested recently at General Electric Co. It eliminates the tool-steel wedges formerly used, which frequently damaged the die holder and the die. The new method employs countersunk set screws instead of the steel wedges. These are located in the shoulder of the die holder and are set at an angle of about 20 deg., so they exert both a lateral and a slight downward pressure on the die. With this new method the die must be flared out somewhat at the bottom, and the die holder recessed to receive it.



Mass Assembly Methods

Ford Engineers to Army



(Above) A stabilizer nearing completion

(Below) A rudder taking form at the Ford glider plant



WHEN the Ford Motor Co. began converting its vast woodworking plant at Iron Mountain, Mich., to glider manufacture, three large factory buildings had to be stripped of most of their peacetime equipment. Previously the plant built Ford truck and station wagon bodies; now it is turning out Army CG-4A transport gliders of Waco design. Recently the Ford company received from the War Department another glider contract totaling \$31 millions.

The CG-4A glider, which also is being built by the Boeing Aircraft Co., Timm Aircraft Corp., and others, is intended for transporting troops and cargo. Having a load capacity of 3000 lb, it can carry a fully-manned Jeep or 15 soldiers with complete equipment. The CG-4A (empty) weighs 3000 lb, has a wing span of 84 ft and a length of 52 ft. A glider of this type, loaded with freight, was towed recently across the Atlantic Ocean to England by a Douglas C-47 transport plane, the trip of 3500 miles being made in 28 hours.

During the conversion period at the Ford plant, hundreds of machines, some in service since the days of the Model T, others of recent manufacture, were hauled to storage to make way for over 4000 jigs and fixtures. Out of the buildings were removed Lindermans, which ingeniously dovetail narrow boards to create wider ones; double-end tenders for cutting stock, automatic shapers, high speed molders, stickers, scroll saws, mitre saws, boring machines, single-edge knife tenders, single-end saw tenders, blower and conveyor systems. From Building No. 3, previously used for the fashioning of truck

Adapted by

3-Ton Transport Gliders

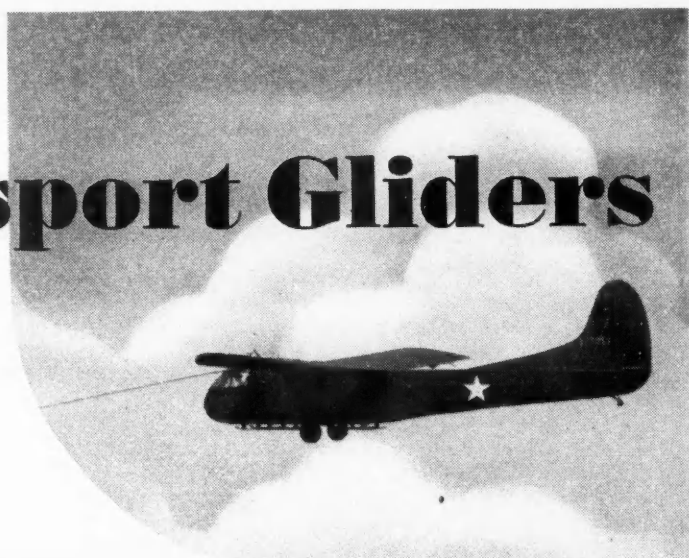
and station wagon body sections, were taken wood-working machines, overhead conveyor tracks, tables, miscellaneous mechanical equipment and a blower system. Out of 300 machines less than 100 remained in the building.

Sixty machines were removed from Building No. 2, most of them having been used for the manufacture of wooden parts going into Ford-made Jeeps, stake and platform cargo truck bodies. Part of this machinery also was utilized to turn out stock trays, office tables and shelving for the Bomber Plant at Willow Run and other Ford war plants. Building No. 1, used originally for the assembling of Ford station wagons, was completely denuded of its equipment. The Pattern Shop, between Buildings No. 1 and No. 2, was left intact. The loading dock at the end of the latter building was also untouched. Retained in the new production setup were the dry kilns. Four of these were converted into glider part storerooms. Others were used for the storage of the dismantled machinery. Two of the kilns at the end of Building No. 1 were cleared to serve as halls for the initial stages of fuselage assembly.

New Equipment

Building No. 1 was rapidly furnished to serve as the final glider assembly line. A revised air-conditioning system was constructed. New overhead conveyor rails were fastened into place. In the rear of the structure, two broad down-draught spray booths

Here the fabric is being added to an inboard wing. It is treated with weatherproofing and stiffening preparations, then sprayed with camouflage paint



Loading the CG-4A glider at Montreal for the unprecedented trip across the Atlantic Ocean.



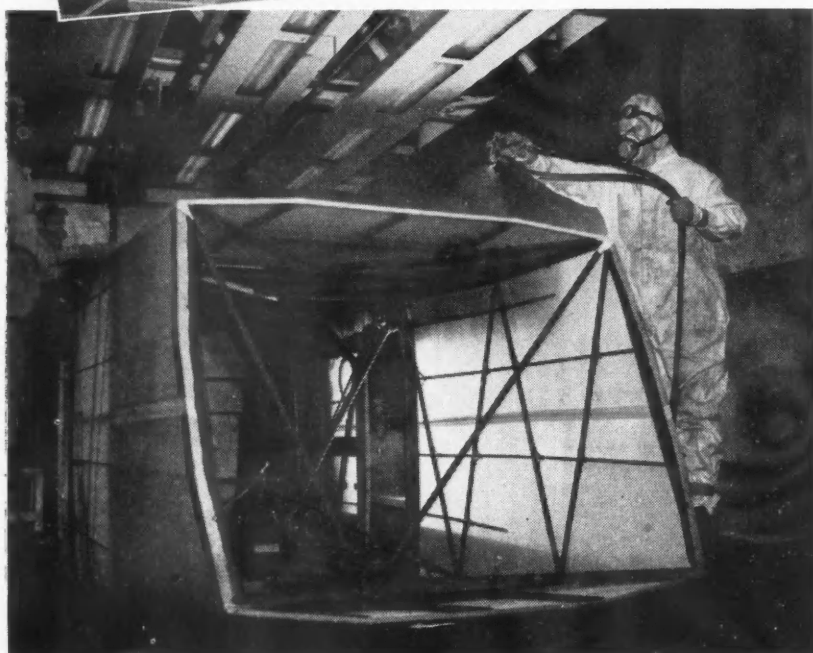
August 1, 1943



(Top) An outboard wing receiving its plywood skin



(Center) Main assembly line for the wings



(Bottom) A fuselage section in the dope room

were erected, each large enough to house the bulkiest of the glider sections during painting processes. The front part of the building where the major sections of the glider were to be joined into finished products was also re-equipped. Another conveyor system was devised and small fixtures built, the latter to take care of the final assembling of the nose.

In a long balconnaded loft suspended over the forepart of the structure a unique tailoring shop was established. Batteries of sewing machines were set up in between long tables. Former Ford mechanics and ex-lumber jacks were then trained to cut and tailor tough cotton fabric for the wings, fins, rudders and fuselages of the gliders. A corner of the auditorium-like room was given over to packing box assembly. These cottage-sized containers were later used in the shipping of the dismantled planes to Dearborn for re-assembly. Generous space on a side of the room was reserved for the huge trucks in which the winged transports were to be shipped.

Following a precisely-planned mass production setup, one which never before had been applied to glider-making, Building No. 3 was equipped to serve as the main assembly plant. At one end fixtures were set up for the fabrication of rudders and fins. Other Ford-designed devices were erected nearby for the making of elevators and stabilizers, glider floors, dorsal fins and ailerons. Other sub-assembly departments were equipped to build doors, door frames and miscellaneous parts. In other sections of the building machines and fixtures were installed for the cutting of plywood skins and the fashioning of thousands of plywood, spruce and poplar parts going into the winged transports.

Dominating this building are

(Upper) Floor and fairing are installed here to the center fuselage section

(Lower) This wing assembly fixture is equipped with rubber tubes which, when swollen with steam, quick-dry the glue joints through the application of both heat and pressure

towering steel fixtures, which were set up in the center of the Building to handle outboard and inboard wings. Over them were constructed a continuous monorail conveyor, that fed into Building No. 1. Seven cranes, serving the principal assemblies, were installed. Among other elaborate equipment added to the building was a humidifying system. Whirling filmy clouds of steam overhead this device maintains temperature and humidity at degrees specified by the Government, insuring the desired water content of the wood going into the glider.

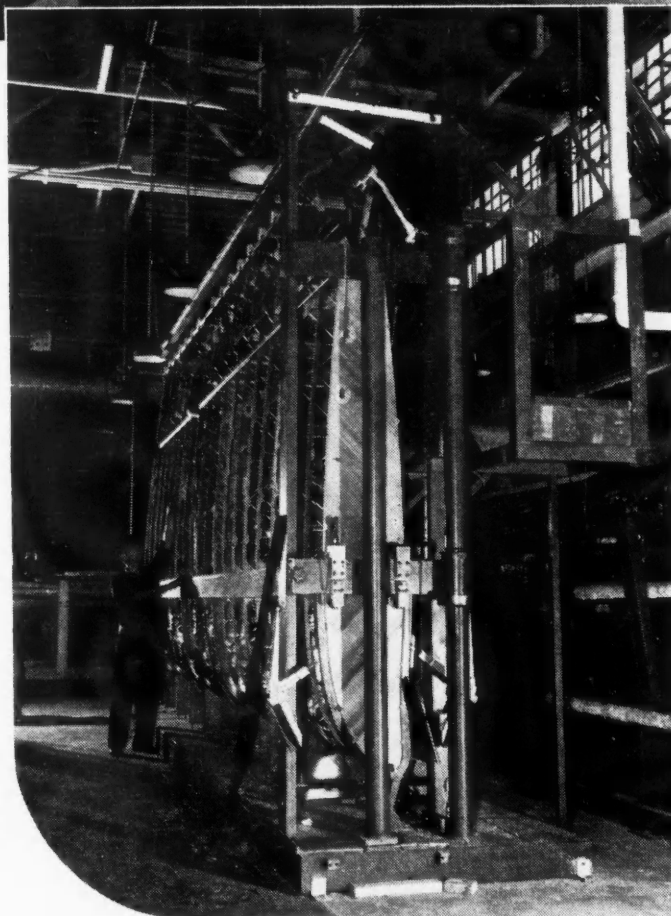
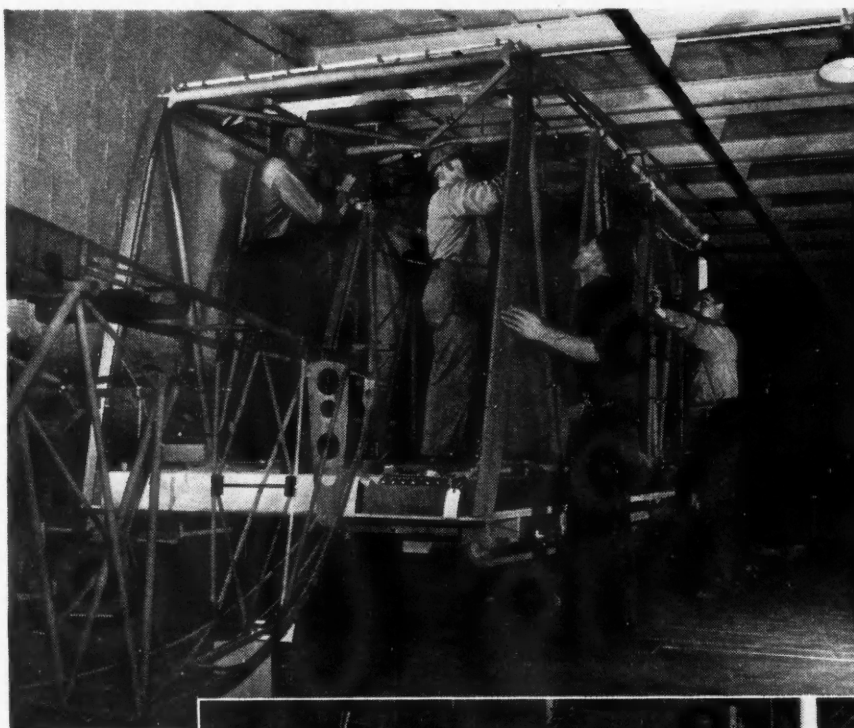
Fixtures

Among Ford-designed fixtures erected in Building No. 3 are a number that are striking contributions to the field of glider-making. Not only have these novel fixtures slashed hours off assembling time, but they do the work more thoroughly than it had been done before. Some of the fixture innovations cut as much as eight hours from various glue-drying processes.

The rapid drying of the glue achieved through the ingenious use of a series of flat rubber veins fitted into fixtures where contact is made with those areas to which glue had been applied. Swollen by steam, channeled from the building's heating system, the rubber veins, through the simultaneous application of heat and pressure, quickly dry the glider parts. Variations of this method, in which electricity and steam are combined, also was used to lower production time. Largest of these fixtures are those in which the wings are finally assembled. Other imposing fixtures glue plywood skin to the outboard wing.

While the steam-inflated rubber veins are used mainly to quick-dry plywood skin to the skeletal structure of the glider sections, electric heat is called into play where movable, shoe-like steel jigs reach areas that cannot be contacted by rubber tubing. Virtually every essential part of the glider is glued together by either steam or electricity, or a combination of both. Illustration of this is found in the production pattern of the wing assembly.

Fabrication of the front spar of the outboard wing begins in a

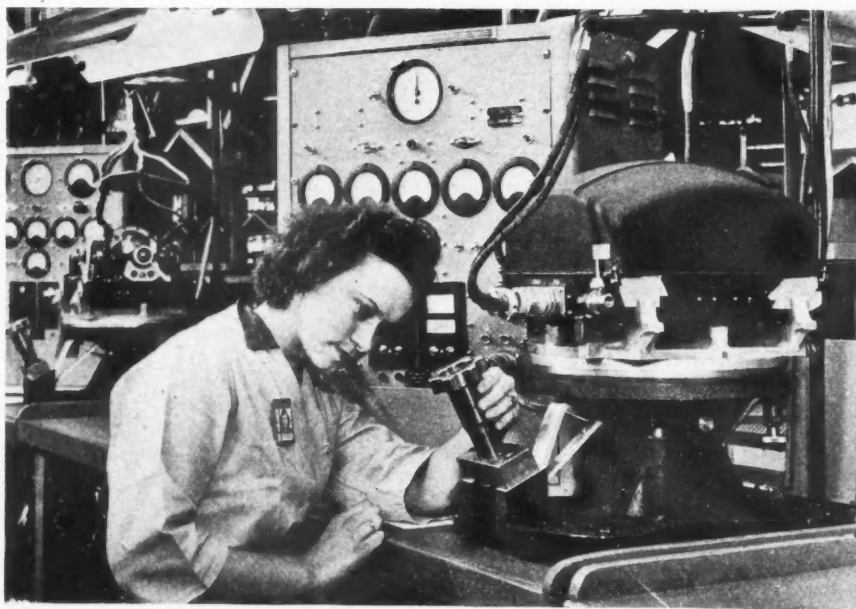


wood fixture. A cap strip of laminated spruce and plywood is set in, bulkheads of the same wood fitted to it and then covered with a plywood skin. The spar is then removed, turned over and returned to the fixture and skin applied to the other side. The fixture cover,

in which is embedded a network of rubber tubing, is then clamped down and steam released into the veins.

Following the drying, the sides of the spar are shaped and holes bored on the inboard end for junc-

(Turn to page 46, please)



(Above) An initial saving of \$12,000 was made by AC engineers who designed the micro adjustable table for use in conjunction with the analyzer on the vertical gyro. In addition, this type of table can be tilted at the desired angle more quickly than by the crank and gears methods.

(Below) Balancing and adjusting the gyroscope gear with the worm gear below is a job that requires careful work. A processed silk cover protects the rest of the mechanism from dirt during the process.

CAN automotive mass-production methods be applied to the manufacture of ultra-sensitive mechanism demanding chronometer-like precision? The answer is found in the AC Spark Plug Division, General Motors Corp., where Sperry automatic pilots are being built in large quantities by straight-line production methods.

The Sperry automatic pilot is designed to perfect the accuracy of bombers by maintaining the course of the airplane in a fixed direction, at a predetermined altitude, and in a horizontal attitude while on the target. At its objective, the automatic pilot is synchronized with the bomb-sight to effect the amazing accuracy for which U. S. Army bombers are noted.

The automatic pilot is composed of two independent units—the vertical main gyro, and the azimuth gyro—each of which is produced as a separate assembly. The vertical unit is an integration of some 1600 individual parts; the azimuth unit, of about 900 parts. The components range from the large frame aluminum die-castings to tiny gears—



(Above) Part of a battery of Gorton milling machines, this one milling an individual pad on one side of a driver lever.



quite like watch parts—as small as $\frac{1}{16}$ -in. pitch diam, 64 pitch.

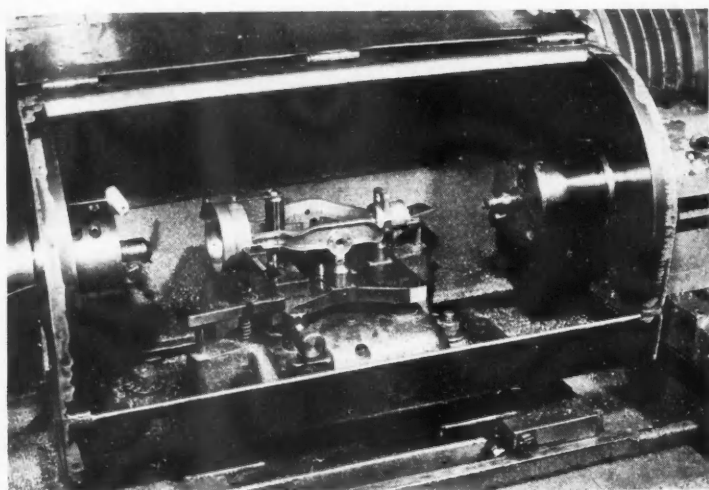
Drawing upon its resources as one of the most prominent suppliers of parts and instruments in the

industry, AC has developed what is thought to be the most highly specialized production set-up for the manufacture of the automatic pilot of this particular type. The equipment, the manufacturing techniques, and assembly methods all follow the pattern for which the automotive industry is noted.

Use Automotive Methods

Automatic Pilot Production

By Joseph Geschelin



Here is a special Ex-Cell-O double-end precision boring machine tooled for boring large die castings.

To appreciate the character of the job, consider just a few of the limitations imposed by the tolerances specified for parts and sub-assemblies. For one thing, tolerances on bores and fits range from 0.003 in. (which is coarse) to as low as 0.0003 in. In sub-assembly operations, some specifications allow for no tolerance at all. This is true of the static balance of the gyroscope unit. It is true of gear train assemblies where gears must be mated without back-lash but with maximum freedom—almost a paradoxical requirement.

These few illustrations, chosen at random, will enable the production man to visualize the need for finely designed fixtures in machining and assembly, the need for precision gaging equipment, and above all the special role of cleanliness. For example, the tiny ball bearings used for mounting the gyro assembly are inspected and stored in an enclosed booth, pro-

The task of statically balancing a gyroscope assembly is one of the most exacting in this department, as no tolerance is allowed. The gyroscope assembly is so accurately balanced that it will stay in any position it is placed despite table or room vibrations. Even the fixture on which it is balanced may be revolved around it without changing the position of the gyroscope itself. Balancing an assembly may require only a half hour or it may take a half day.

vided with filtered air. Assembly operations on the benches are handled under glass to prevent the entry of dust and lint. All parts that go into assemblies are kept in sealed wrappers of cellophane or Kero seal until used.

Due to the nature of production tolerances, the machinery, particularly finishing equipment such as grinders, must be so mounted as to be free from vibration and free from outside disturbances. Moreover, temperature plays a vital role. No metal cutting can be done until the temperature of the machine and cutting fluid are at a constant level. In fact, some of the equipment must be operated 24 hours per day, day in and day out, to assure the maintenance of

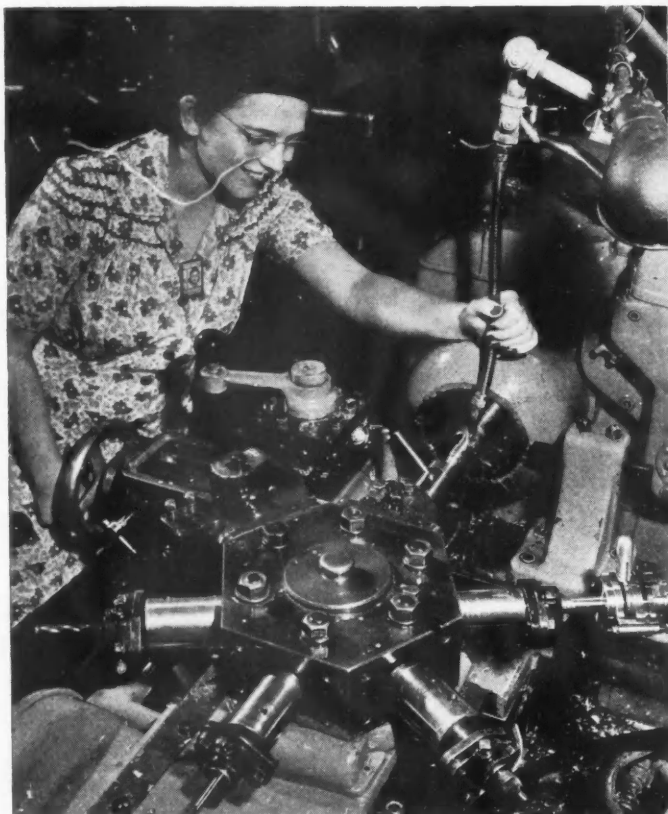
this constancy of temperature.

Coming to the details of manufacture, consider the assembly department. Here will be found what is

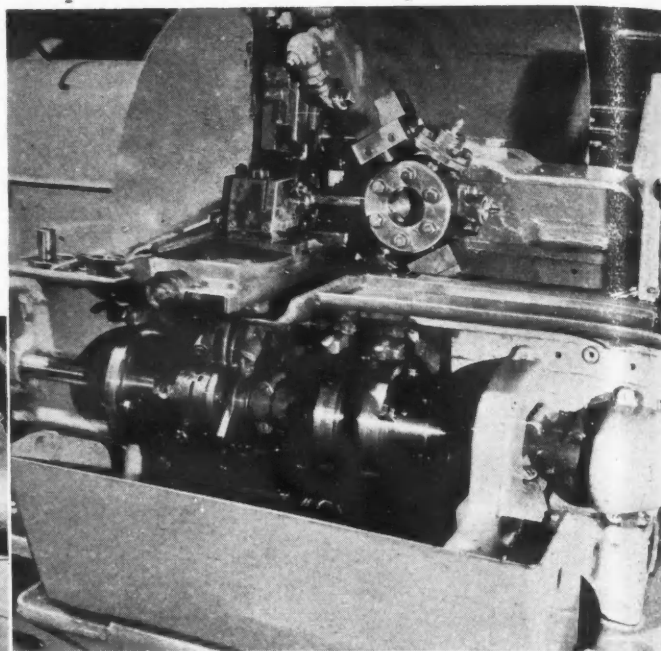
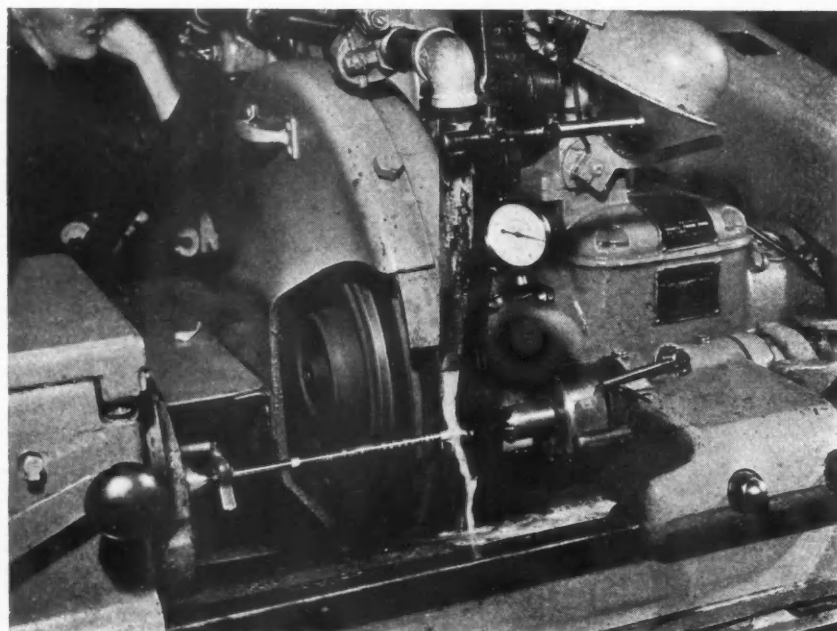


(Right) Close-up of one of a large battery of finely tooled Brown & Sharpe automatics in the screw machine department.

(Below) Here is one of a large battery of Bardons & Oliver turret lathes in the screw machine department.



(Below) Norton cylindrical grinder in the grinding department—finish grinding a lead screw shaft of small diameter.

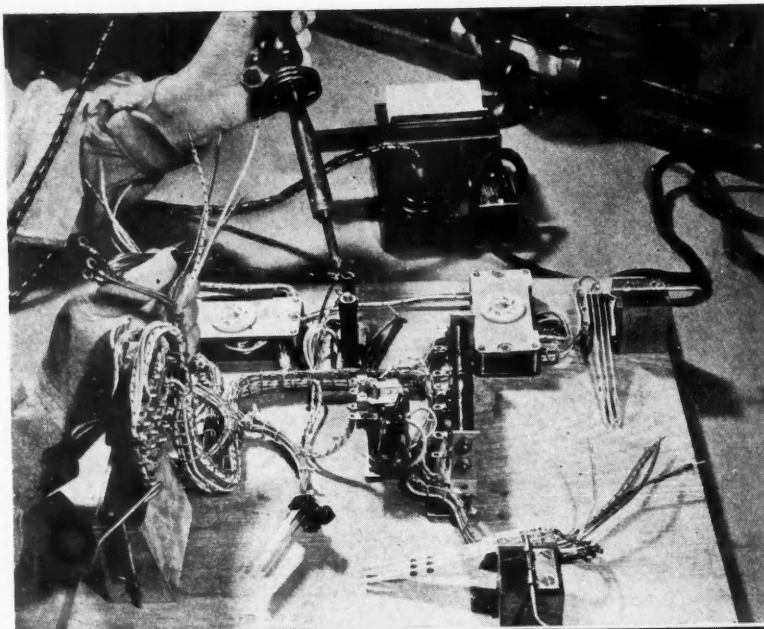


thought to be the first conveyORIZED assembly operation applied to the manufacture of fine instruments. To visualize this department, picture a central row of sub-assembly benches, each of which is set up to handle a specific part. These benches are traversed and enveloped by two separate systems of monorail conveyors. The conveyor on one side of the department transports parts and sub-assemblies to an outer assembly line for the vertical gyro unit; the other serves a similar assembly group for the azimuth gyro unit. Each conveyor moves between two parallel rows of final assembly benches flanking the sub-assembly benches, thus doubling the output of the line within an extremely small compass.

Parts for the assembly department are inspected on receiving benches just outside of the department, clearing all parts whether from AC machine shops or from outside sub-contractors. Gages used here and on the assembly benches are checked and calibrated in an air-conditioned gage room.

Workers in the assembly department have been carefully trained for their appointed tasks. The women operators are constantly under the supervision and guidance of set-up men whose duties also include a constant study of operations leading to simplification and improvement in methods. One of the features of assembly stations is the use of micro-motion methods in laying out each operation. In addition, each work bench is provided with a wood assembly board, for storage and positioning of the component parts, with an instruc-

The old method of soldering the wire harness on the vertical gyro inside the main casting was difficult, and AC engineers developed a fixture whereby this work can be done outside and the completed harness then placed in the casting. By this new method parts are snapped into place on an assembling board where the soldering is done.



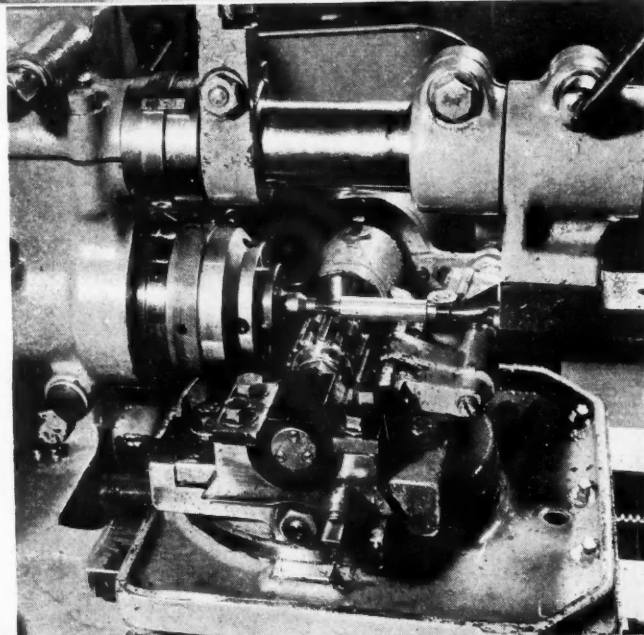
tion chart giving the exact steps for making up each sub-assembly.

Static balancing of the gyro assembly is one of the most exacting tasks in this plant. There is no tolerance on this operation since the gyro must be free to repose in any set position despite outside vibration. To simulate operating conditions, each of the gyro balancing benches is excited to constant high frequency vibration while the operation of balancing is in progress.

Major advance has been made in the method of wiring harness installation. Discarding the conventional procedure of installing harness in the housing and then soldering the multiplicity of connections, AC engineers developed a unique harness fixture in which the wiring is assembled to the required configuration and completely soldered at all connections. The assembly then is installed in the main frame of the vertical gyro, snapped in place, leaving only a few connections to be soldered at this stage. This procedure has reduced man-hours by more than 50 per cent, at the same time greatly facilitating the task of the operators.

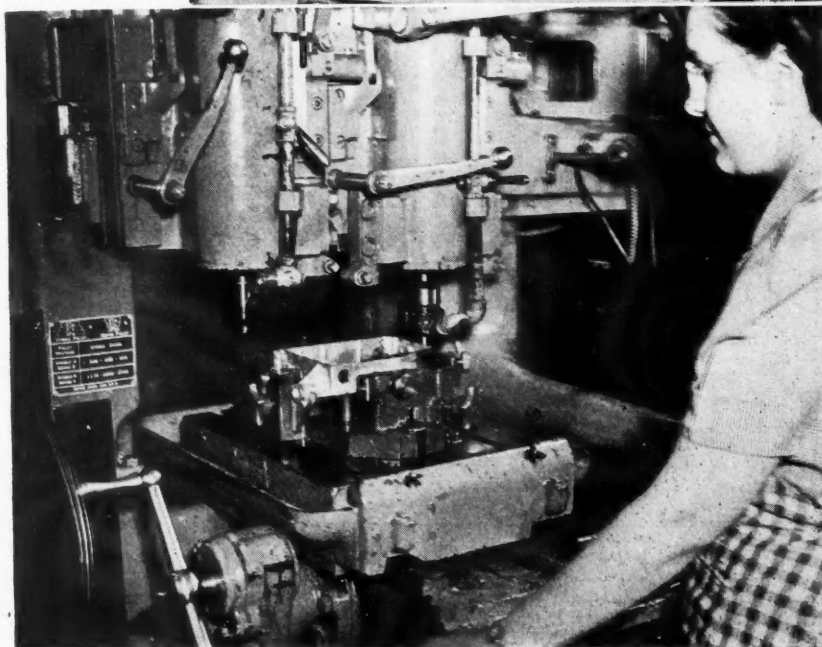
It is of interest to learn that AC designed and built all of the fine electric testing equipment used in the assembly department. One example of instrumentation is the micro-adjustable universal tilting type table which saved about \$1,000 of cost per table. Another is the automatic high potential test equipment for testing plug and cable assemblies for the wiring harness and other connections. This unit is arranged to test 15 assemblies or plugs simultaneously. It is automatic in function, stopping when an insulation fault or ground is encountered, making it possible for a single operator to run a battery of such testers if necessary.

(Turn to page 66, please)



(Center right) In the gear department—Barber-Colman hobbing machine set-up for cutting a long spur gear shaft.

(Right) One of a large battery of Pratt & Whitney profiling machines, this view showing the milling of a slot in a base casting.



Producer Gas for

THE use of gasoline and other petroleum products for small, high speed internal combustion engines has been so general in North America that few serious attempts have been made to employ other fuels in this field. The convenience and compactness of gasoline and, until recently, its low cost have discouraged competition, but wartime restrictions and transport difficulties have created fresh interest in the search for suitable alternative fuels. Other countries, less favorably situated than Canada is, with regard to supplies of petroleum products, have already explored this field and are able to subsist, at least to some extent, on home-produced fuels.

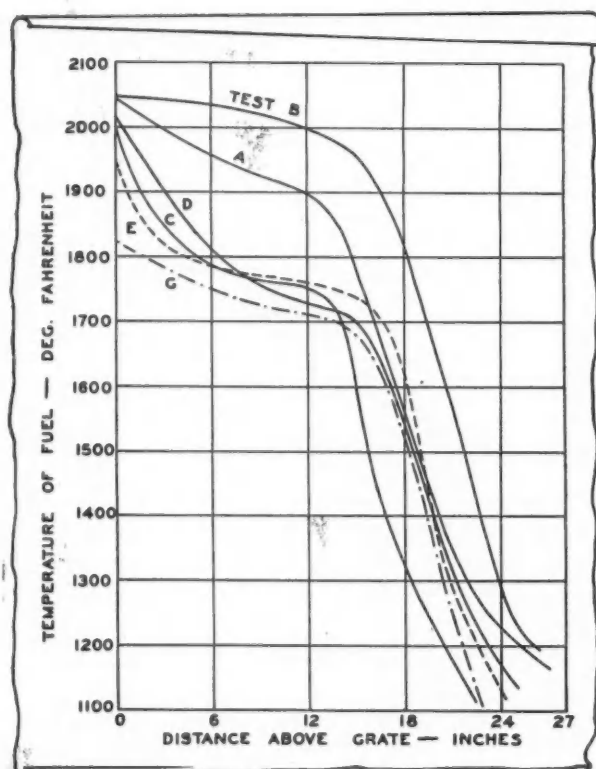


Fig. 1—Fuel temperature in a small up-draft gas producer using anthracite. Water feed in pounds per pound of coal burned: Test A-0.016, Test B-0.232, Test C-0.421; Test D-0.724, Test E-0.718, Test G-1.140.

OF late we have had many inquiries regarding gas producers adaptable to motor transport and because of its comprehensive coverage of that subject we are presenting a paper written by E. A. Allcut, Professor of Mechanical Engineering at the University of Toronto. Articles describing alternate fuel equipment for gasoline engines that has been placed in service in Finland, Switzerland and England were published in the May 1 and May 15, 1941, and August 1, 1942, issue of *AUTOMOTIVE and AVIATION INDUSTRIES*.

The properties desirable in a fuel that is to be used for automotive purposes are:

- (1) *Mobility* in the intake manifold, so that the fuel will be distributed evenly to the various cylinders and will mix well with the air supplied for combustion. This points to a gas or vapor—preferably the former.
- (2) *High anti-knock rating*, so that advantage may be taken of the increased thermal efficiency obtainable by using high compression ratios.
- (3) *Complete combustion* in a short time, and absence of deleterious gases in the exhaust.
- (4) *Minimum wear*, corrosion or clogging in cylinder and valves.
- (5) *No contamination* of spark points or lubricating oil.
- (6) *Flexibility* with variations of speed and load.
- (7) As near as possible, the same *mixture strength* for maximum power and best economy.
- (8) *Low cost* and relative *safety*.

The principal objections to gasoline are:

- (a) Its tendency to *knock* with high compression ratios.
- (b) *Fire and explosion* risk at ordinary temperatures.
- (c) The maximum *power* is obtained with a *rich* mixture and the best *economy* with a *weak* mixture.
- (d) The *combustible range* of air-gasoline mixtures is comparatively small.
- (e) If power, acceleration and easy starting are required, the exhaust gas contains dangerous quantities of *carbon monoxide*.
- (f) The control for different speeds and loads is complicated.
- (g) *Distribution* is poor on account of the presence of liquid drops in the manifold.
- (h) It is *irreplaceable*. Fresh supplies can only be obtained by going further afield, further underground, or both.

Motor Transport

By E. A. Allcut

The last condition applies to many of the suggested alternatives, but with the practical difference that there may be more of the alternative fuels and that the depletion of those resources may be proceeding at a slower rate. Alcohol, for example, can be produced rapidly from growing vegetable matter; wood also is growing, but its rate of replacement is slow. Supplies of anthracite coal are few and restricted, but bituminous coals and lignites are relatively abundant. Synthetic fuels, generated by the hydrogenation of coal or by the combination of carbon monoxide and hydrogen (produced from coal or coke), cannot be usefully considered at this time because of the high cost of the plant, the time required to build it and its comparative vulnerability to air attack. The hydrogenation process has been used both in Great Britain and Germany, but in these instances the important arguments in its favor were probably its usefulness in wartime and the political and economic necessity of providing employment for the coal miners. Compressed and liquefied gases, such as methane (from sewage), natural gas, propane, butane, coal gas and hydrogen, have been used satisfactorily, but these are probably unavailable at the present time because of (1) the difficulty of obtaining compressing plant for gas pressures which may be as high as 3000-5000 psi; (2) the shortage of steel suitable for storage bottles; (3) the lack of the manufacturing facilities necessary for producing light bottles or containers to resist high pressures. During the First World War, many vehicles were equipped with balloons containing coal gas at atmospheric pressure, the gas being fed to the engines through mixing valves. This arrangement involves a power reduction of about 10 to 20 per cent as compared with gasoline, but in other respects appears to work well. The principal difficulties are, the small radius of action round the filling station (about 20 miles total run) and, at present, the shortage of rubber which is used to make the balloons gas-tight.

Pulverized coal engines have been the subject of extensive experimentation in Germany and it is claimed that a considerable measure of success has been obtained with them. The principal difficulties are due to the fouling of the cylinder and oil by ash and tarry matter, together with burning and erosion of some of the surfaces. As far as the author is aware, no commercial installations have been made on high speed engines. Numerous attempts have been made to employ acetylene gas with and without the addition of alcohol to suppress knock, but all of these have failed commercially. Benzol, obtained by the distillation of

coal or wood, has been used quite extensively in Europe for blending with gasoline. This has the advantage of increasing the knock rating, but the quantity available is small and it has a relatively high freezing point (42 F).

Apart from petroleum products (which are not being considered here) the only other liquid fuel that is likely to be suitable is alcohol which, before the war, was produced in 40 countries at the rate of 200 million gallons per annum. Several European countries had laws making it compulsory to add from 10 to 20 per cent of home-produced alcohol to all imported gasoline. In others, the use of the blend was optional. Bulletins

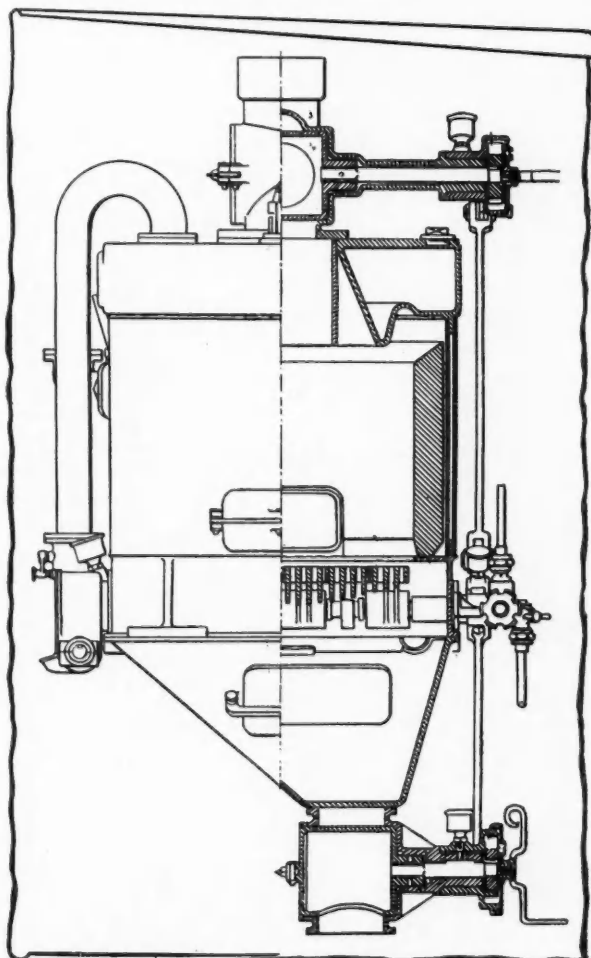


Fig. 2—Early portable gas producer (Col. D. J. Smith), 1919. Grate dia. 12 in.

on this subject have been published in Great Britain, Australia, and Canada.

Producer Gas

The production of alcohol on a relatively large scale is not likely to cover much more than 10 per cent of our requirements, and the only reasonable remaining alternative appears to be the production of gas as and when it is needed for power production, thus avoiding problems of storage. The gas is usually produced from anthracite, coke, wood or charcoal, though other solid fuels or waste products have been employed. A supply of air, insufficient for complete combustion, is passed through the fuel bed and heat is produced by the reaction:—

$2C + O_2 = 2CO + 4400 \text{ Btu per lb. of carbon consumed.}$ In most instances water or steam is added to the air (or it may be derived from the moisture in the fuel) giving rise to two reactions:

$C + H_2O = CO + H_2 - 4300 \text{ Btu per lb of carbon consumed.}$

$C + 2H_2O = CO_2 + 2H_2 - 2820 \text{ Btu per lb of carbon consumed.}$

The use of steam, therefore, enriches the gas by the addition of hydrogen and tends to prevent excessive temperatures and the formation of clinkers in the fire. The latter are undesirable because they obstruct the flow of air and tend to cause hollow spots and channels in the fire, with a consequent reduction in the quality of the gas. These reactions and the effect of fire temperature on them were discussed in a paper written by the author in 1910. It was there shown by means of temperature curves (Fig. 1), that, in a small producer, the process of gas generation could be completed with a fire depth of 12 inches or less and that, beyond that point, the superincumbent layers of fuel are useful only as a fuel reserve and are actually detrimental as far as the quality of the gas is concerned. It was found that the best efficiency was obtained

when the ratio of $\frac{\text{water}}{\text{coal}}$ feed was about 0.75, and

that about 72 per cent of the water was decomposed into carbon monoxide and hydrogen.

In the case of mobile producers for cars and trucks, it is difficult to provide suitable controls for regulating the water feed automatically, to suit varying loads, speeds and accelerations, and for this reason many of the modern producers have no water supply other than that obtained from the moisture in the fuel, which sometimes is made to flow through the hot fire. In general, the temperature of the fuel bed in an up-draft producer using anthracite, should be between 1800 and 2200 F to give a good gas in the short time available. The composition of the gas varies under different conditions, but it usually has a calorific value of 110 to 140 Btu per cubic foot and contains about 20 to 30 per cent carbon monoxide, 4 to 12 per cent hydrogen, and 55 to 62 per cent nitrogen. The high percentage of nitrogen and poor calorific value make this gas unsuitable for storage purposes, and the presence of carbon monoxide is always dangerous.

It has been stated that one of the earliest mobile producers was designed by J. W. Parker who "between 1901 and 1903, ran something like 1000 miles in Great Britain, at first with a 2½ hp car and afterwards with a 25 hp car, carrying several passengers." The author tested producers designed by Col. D. J. Smith (Fig. 2) and Mr. Parker (Fig. 3), respectively, on a car, trucks and a motor boat, in 1919-20, and reported that, while encouraging results were then being obtained, the apparatus was not designed and constructed in such a manner as to make it immediately suitable for commercial development. Messrs. Thornycroft of Basingstoke, England, produced one of the earliest commercial designs in 1922, and manufacturers in France, Germany and other countries rapidly followed suit.

These plants proved to be so popular in countries having no petroleum, that in 1937 France had 4436, Germany about 2000, Japan and Italy about the same number, and since the outbreak of war these numbers have probably been greatly increased. Russia was expected to produce 16,000 trucks and 9000 tractors in 1939, and 40,000 and 15,000, respectively, in 1940. Other countries which have been over-run by the Germans are stated to be almost entirely dependent on this type of prime mover.* A British report states that "producer gas can be recommended as a means of maintaining road transport in operation in an emergency," but that, in peacetime, at the present stage of development it "is of doubtful economic value for motor vehicles, except in specially favorable circumstances, e.g., for long distance work with vehicles carrying medium or heavy loads." A specially designed

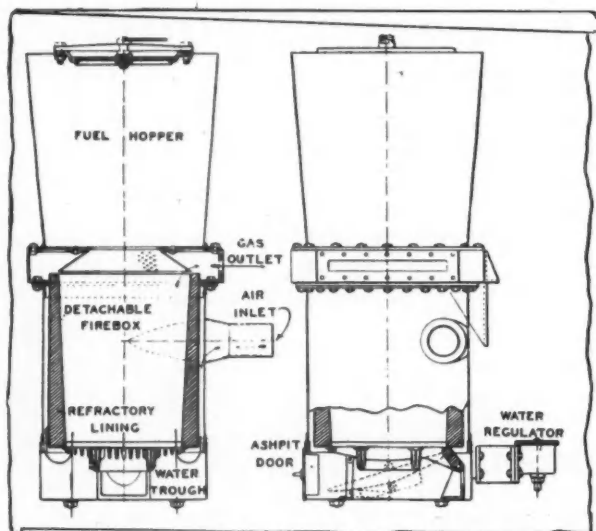


Fig. 3—Early portable gas producer (Parker). Grate dia. 11¼ in.

*It is reported that in German occupied countries there were 150,000 producer-gas trucks on the road in the fall of 1941 and that 33,000 more were scheduled to be produced between October, 1941 and March, 1942. In addition, 20,000 tractors operating on producer gas were expected to leave the factories in 1942. Sweden had 66,400 vehicles working on producer-gas in August, 1941, of which 33 per cent were private cars. About 40 per cent of the total used wood fuel—the others employed charcoal. France now has 50,000 producer-gas vehicles, mostly using charcoal, and Switzerland about 2,000. (*Engineering*, Feb. 6, 1942 and *The Autocar*, Jan. 30, 1942).

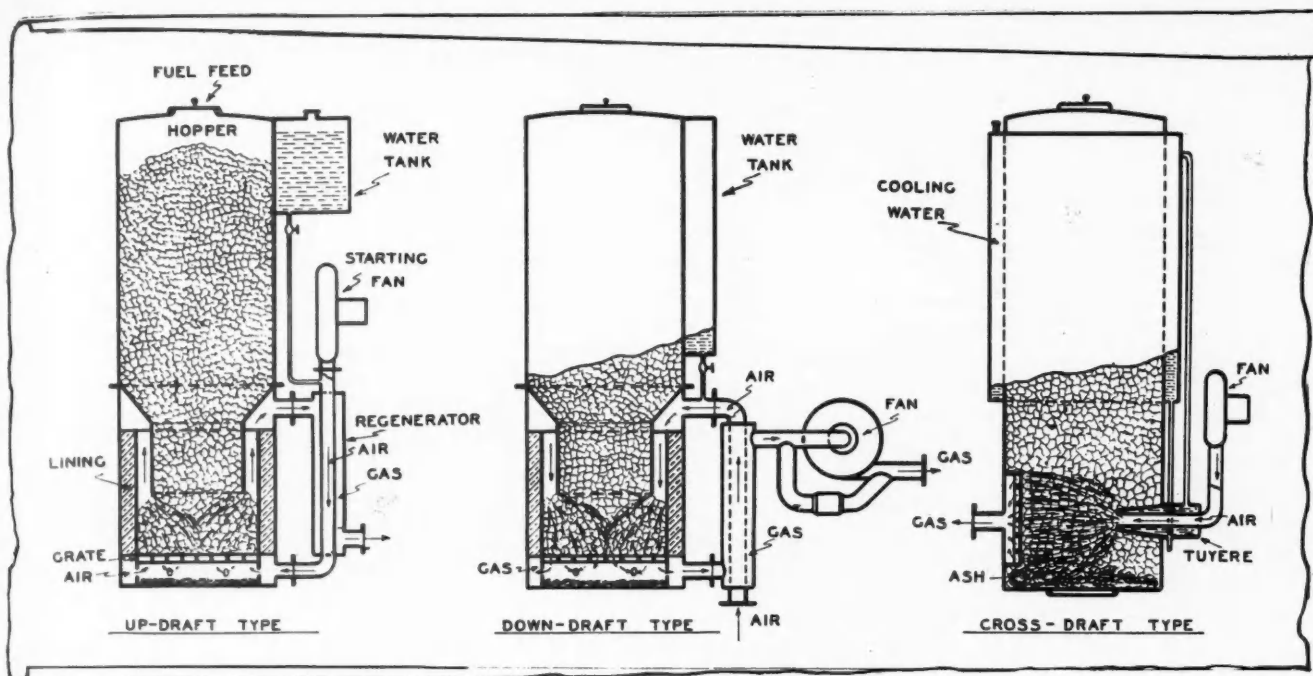


Fig. 4—Up-draft, down-draft and cross-draft producers

equipment was recommended by the Committee for emergency use, and was based on the results of "400 road tests, covering approximately, 50,000 miles, using 9 vehicles, 22 producers of nine different types and over 120 distinct fuels." It is also stated that the "average driver of a petrol-driven vehicle can learn to operate a producer gas vehicle in a few days, though he will continue to improve for a much longer period."

Design of Plant

The portable producer plant consists of three principal parts, namely, the gas producer or furnace, the arrangements for cleaning the gas and the mixing valve.

The producer may be of the updraft, down-draft or cross-draft types (Fig. 4). The early producers almost invariably had the fuel feed at the top, the air and steam being introduced below the grate. The producer was lined with refractory material and had a built-in boiler or evaporator (which might be at the top, bottom or surrounding the body as a water jacket); the grate was usually of the "shaking" type and the ash was withdrawn from the bottom, either by hand or through a mechanically operated valve (Fig. 2). The gases were taken off at the top of the producer, so that any moisture in the fuel was removed by evaporation and did not produce any appreciable quantity of hydrogen. In these circumstances, the provision of steam was almost a necessity to provide gas of reasonable calorific value. Also, much of the volatile matter in the fuel left as tar, causing trouble in the cleaning apparatus and sometimes also in the engine.

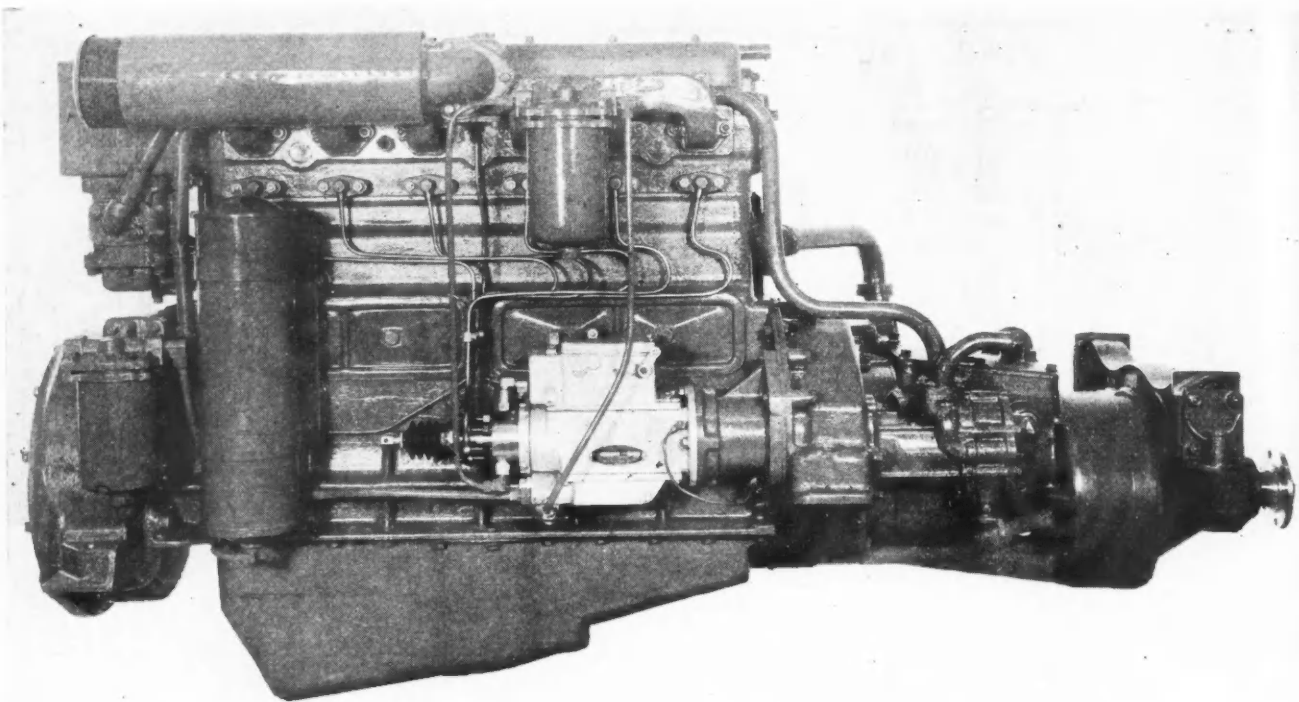
In the down-draft producer, the air and steam are admitted above the fire and the gas is taken off either at the bottom or about half way down the furnace. The moisture and volatile hydrocarbons are thus made to pass through the high temperature zone and are

partly decomposed into hydrogen, carbon monoxide and fixed hydrocarbons, which enrich the gas. The latest tendency is to use the cross-draft type, in which the air enters through a tuyere or nozzle near the bottom of the furnace, and the gas is taken off through a grid on the opposite side, the flow thus being horizontal. This provides a simple and compact arrangement incorporating the chief advantages of the down-draft principle. The tuyere may be cooled by water from a "radiator tank" and the upper part of the producer is a simple unlined cylindrical vessel, which acts as a fuel storage. One filling usually suffices for a journey of 100 to 150 miles. Where the length of gas travel through the furnace is fixed by the width of the producer, the time of contact between gas and fuel is necessarily small.

Experiments were made at Melbourne on a small producer (6 hp) with fire lengths varying from $1\frac{3}{4}$ to $6\frac{1}{4}$ inches and at $2\frac{1}{2}$ inches a good gas was obtained of net calorific value exceeding 130 Btu per cu ft with gas discharges between 3.0 and 6.3 cu ft per minute. Water was admitted to the extent of 3.3 lb per 1000 cu ft of gas generated, giving 6.5 to 10 per cent of hydrogen in the gas. The best gas was obtained with a fire about 4 inches long, and the "transit time" was less than $1/100$ second.

(End of Part One)

Part Two will be published in an early issue of **AUTOMOTIVE and AVIATION INDUSTRIES**



Chrysler M-12 Diesel Marine Engine of 331 cu. in. Displacement

Chrysler Diesel Engines

CHRYSLER Division of the Chrysler Corp., recently added two types of Diesel engines to its line, an industrial (Ind-3) engine and a marine (M-12) engine, which are handled respectively by the Industrial Engine Division and the Marine Engine Division. In general these engines are of similar design, with the variations indicated by the nature of the service for which they are designed.

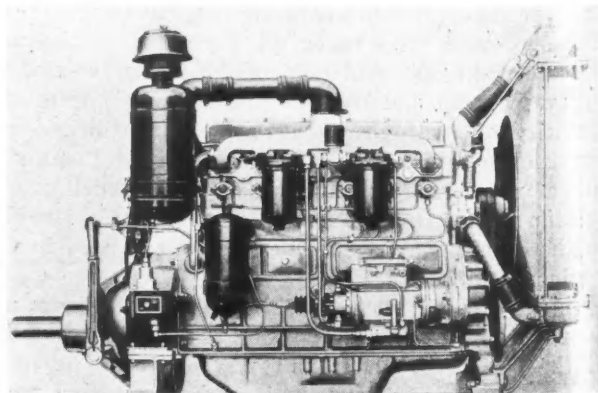
The Chrysler Diesel engines are of the six-cylinder type, with a bore of $3\frac{3}{4}$ in. and a stroke of 5 in., giving a piston displacement of 331 cu in. The maximum brake horsepower is 82 for the marine engines at 2400 rpm and 80 for industrial engines at 2000 rpm. The fuel consumption is .45 to .46 lb per bhp-hr at 1200 to 1800 rpm. There are seven main bearings of 3 in. dia with a projected area of 36.89 sq in. The camshaft has six bearings. Full-length water jackets are provided with a by-pass thermostat. The electrical starting system has a 24-volt capacity with a generator capacity of 5 amps. and 30-volts. The combustion chamber is of the energy cell type, with a compression ratio of 14.75 to 1. Compression pressure is 450 psi at 1000 rpm.

Fuel injection nozzles are of the hydraulic-actuated type with an orifice of the single, pintle type. The fuel injection pump is a one unit multiple plunger type. There is a speed controlled injection timing advance, speed controlled regulation of maximum delivery and a mechanical top speed governor. The

transfer pump is integral with the injection pump. Two fuel filters and an air cleaner are supplied.

Lubrication is pressure to the main, lower connecting rod and camshaft bearings; injection pump; injection pump and camshaft drive and valve mechanism. The pump is gear-driven from the camshaft. An extra large replaceable element filter is provided with an oil capacity of 14 quarts. Pistons are of aluminum alloy steel-strut type, with three compression rings and two oil rings. Valves are located in the cylinder head, with seat inserts in the exhaust valves. One of

(Turn to page 138, please)



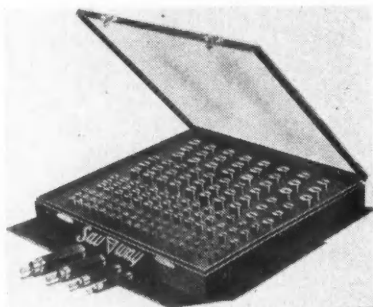
Chrysler Ind-3 Industrial Diesel Engine

New Production Equipment

SAV-WAY Industries, Detroit, Mich., offers a Master Set of standard plug gages for hole inspecting, said to be the first complete master set of standard plug gages available.

The set includes 147 plugs and 4 handles in a plastic case. The case has a transparent plastic cover which presents a clear view of the contents of the case and, incidentally, indicates a missing plug, thus insuring that all plugs are replaced after use.

Plugs are set in increments of 1/64 in., starting at 1/4 in. and going to 1 in.



Sav-Way Master Set of standard plug gages

There are three plugs of each nominal size—.0005 in. over, standard, and .0005 in. under.

All plugs are deep-frozen before finish grinding to relieve internal strain and to provide accelerated aging, and are held to gage makers' (X) tolerance, lap finish.

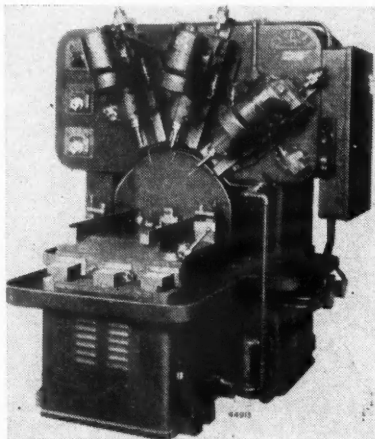
AN automatic machine for milling binder bar slots in forged cylinder heads for aircraft engines has been designed and built by Snyder Tool and Engineering Company, Detroit, Mich. The slots are angularly arranged on three fin sections and all three slots are cut at one time, the work cycle being as follows: With the part located on a master locating plate and clamped on the fixture table, the starter button is pressed and the tools advance into the work and feed to the full depth of 3/16 in. When the full depth is reached, the table automatically moves lengthwise and feeds the work against the tools for the entire length of the cut. At the end of this lengthwise cut,

the tools automatically retract and the cycle is complete.

The finished part is replaced by another part, clamped in exactly the same position from which the finished part was removed. The starter button is pressed and the cycle is repeated with the table moving in the opposite direction for the lengthwise cut. This brings the table back into the position from which it originally started and eliminates the need for resetting the table between cuts.

The tools are double-end, straight shank and mills, and adjustment for wear is provided on each unit through micrometer adjustment screws. The spindles are high-precision, high-speed, ball-bearing type and are driven by V belts from individual, dynamically-balanced spindle motors. Each spindle is operated by an individual hydraulic cycle and all three spindles are geared for simultaneous operation.

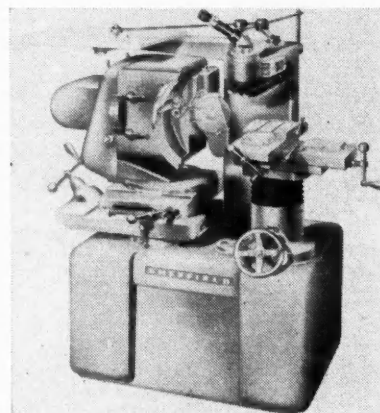
The fixture table is hydraulically operated for the transverse feed stroke and rides on hardened and ground ways with a heavy center guide. The column of the machine carrying the three units also houses the piping and other hydraulic equipment. The coolant pump is mounted on the base and coolant is contained in the front part of the base. The three controls shown on the column are for the infeed of the tools and for the forward and backward feed movement of the fixture table.



Snyder Automatic Machine for milling binder bar slots in cylinder heads

THROUGH the use of a 50 to 1 pantograph and a microscope the Sheffield Micro-Form Grinder, made by the Sheffield Corporation, Dayton, Ohio, is designed to finish grind most accurately every desired profile within its range directly from the drawing.

The machine is especially suited for the grinding of both circular and flat form tools, templates, profile gages, cams, dies, etc., from hardened materials including tungsten carbide. It is not limited by the regularity or ir-



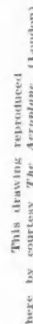
The Sheffield Micro-Form grinder

regularity of the work, nor by straight lines, circular or irregular curves.

A layout drawing made to a scale of 50 to 1 is placed on the drawing table of the pantograph which has a microscope mounted on a short arm. Following the lines on the layout drawing from point to point with the pantograph stylus, moves the microscope equipped with crosshairs exactly according to the profile to be ground. The operators feeds the grinding wheel so that its cutting edge always works toward the point marked by the crosshairs which correspond to the position of the stylus. He does not let the wheel go beyond the intersection of the crosshairs.

An accuracy of .0003 inch is said to be obtained in the grinding operation. Still closer limits can be held after the operator has become reasonably familiar with the machine. This accuracy is in no way affected by wheel wear. (Turn to page 76, please)

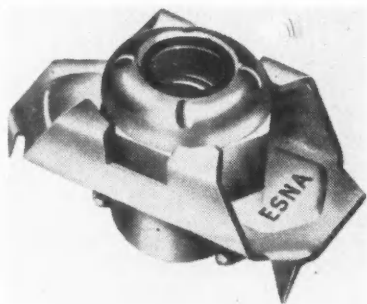
Attachment For
Mounting Ring
Installation Ring
Rubber Pad
Mounting Ring
Supercharger Gear
To Rev. Counter
De-Airing Valve
For Impeller Bearing
Spring-Loaded
Rotor Drive
Connexion Drive
For Starter
Flywheel Starter
Hand Starter



New Products for Aircraft

Stop Nut Developed For Use on Plywood

A new self-locking fastening device for use on plywood construction has been brought out by the Elastic Stop Nut Corporation of America, Union, N. J. It has been tested and approved by the Army Air Corps. The device consists of a regular elastic stop nut, with the red cellulose locking collar, which is interlocked with a basket that locks into the plywood and holds the



The ESNA Stop Nut

nut securely. Four prongs at the corner of the basket sink into the surface of the plywood, and two feet inserted in the hole are forced into the wood as the nut descends, firmly anchoring the basket. Spring fingers at the top of the basket clasp the nut after it is seated, and hold it firm against axial play. This construction makes the nut independent of the thickness of the material; it can be used on plywood from 1/8 in. up. The nut is replaceable without moving the basket, and 8/32 and 10/32 nuts are interchangeable in the same basket.

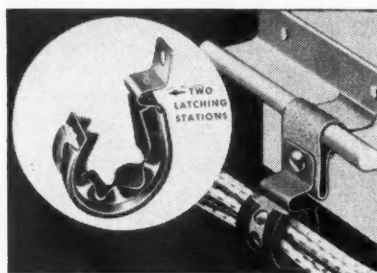
Compound Controls Airport Dust

An inexpensive compound for laying airport dust has just been introduced by The Curran Corporation, Malden, Mass. The newly developed composition is described as a stable homogeneous liquid of relatively low viscosity which may be diluted or extended with water in all proportions. The concentrate and its emulsions are said to be effective in wetting and penetrating over all types of soil, including moist earth. According to the manufacturer,

the new compound may be applied to a soft muddy surface immediately following a rain. Because of a new type of emulsifier used, the oil will wet only the top two inches of the soil since it becomes water insoluble on further penetration. Because of this property, the composition is not dissolved and leaches away into the soil by a following heavy rain. The compound is stated to be safe and easy to handle; is non-corrosive to metal and spray equipment, and contains an effective weed killer.

Latching Wire Harness Clamps

Tinnerman Products, Inc., has designed wiring harness clamps with a latching finger for use in aircraft and other equipment. These clamps work independently of the attaching screw in the assembly of wire harnesses. Any or all of the wires may be removed or replaced without loosening the screw that holds the clamps in position. These clamps are used in place of "boggles" at the point of make-up. They remain snapped over the wires during transportation to final assembly location and then serve as the mounting means for

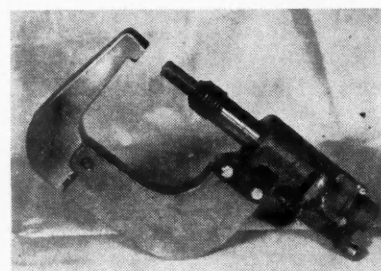


Tinnerman Latching Wire Harness Clamps

attaching harness to structure. They are made of spring steel parkerized and given 2 coats of lacquer, and are cushioned with extruded synthetic rubber channels having integral resilient ribs to absorb variations in thickness of harnesses. Two different latching stations are provided on each clamp for size adjustment to fit varying number of wires. With the resilient ribs and the adjustment feature, 6 sizes accommodates wire bundles varying from 1/16 in. to 1 3/8 in. in diameter.

Tool for New Riveting Process

Ingersoll-Rand Company, New York, N. Y., is manufacturing a new tool called the "Air Buck Jam Riveter" which was developed in the Buffalo, N. Y., plants of Curtiss-Wright Corporation's Airplane Division. The device consists of a regular vibrator with added attachments so that its action is automatically controlled by the "travel" of the driving set. It is designed to work on curved cowling and other specialized parts where gang or indi-



Ingersoll-Rand Air Buck Jam Riveter

vidual "squeezers" cannot operate. One adaptation is a hand tool vibrator with adjustable depth timer attached to a hinged yoke. The second is a vibrator adapted to a special yoke fabricated from cold rolled steel and mounted on a pedestal. Both of these tools may be adjusted for the correct height of the finished rivet, and automatically stop when that point has been reached. The pedestal-mounted vibrator was designed to handle a difficult rivet set problem in the cowl department where it is performing a riveting job which heretofore was almost inaccessible. This tool will handle 5/32 in. rivets. The yoke is made of welded cold rolled steel which gives a live bucking action.

The hand tool has sufficient power to head a 1/4 in. rivet with ease, yet is substantially lighter than an equivalent squeezer and can be easily handled without the aid of a spring balance. Since the whole lower bar pivots from the hinge instead of just a small portion under the bucking area, a heavy blow is delivered on the rivet shank. Where the assembly clearances permit shank driving, these special yokes are not necessary. As the height of the driven rivet itself controls the gun, results are regular and accurate.

(Turn to page 72, please)

Ford Transport Glider Plant

(Continued from page 33)

tion brackets used to join the outboard and inboard wings. After bushings have been inserted, 12 nose ribs of spruce and plywood are placed in fixtures with spar and glued. Steel plates, attached to movable arms, are clamped against glue points and electric heat applied. This drying operation, which ordinarily takes six to eight hours, is completed at the end of 10 minutes. A somewhat similar process is followed in the assembling of the rear spar, with rubber tubing and electric plates speeding the fabrication.

After spar is assembled, shaped and fitted with bushings and brackets, it is laid in jigs in a steel fixture and glued to center ribs. Steel plates, heated by steam, are used for drying. The rear spar then is removed and transferred to another fixture where it is glued to the front spar. In this operation electric heating units are used. Among other novel fixtures are those used to join the center rib assembly to the nose rib assembly. These are equipped with electrically-heated clamps. Steam and electrically heated fixtures also are used in the sub-assembly departments. In addition to these, batteries of electric lights are used to quick-dry smaller assemblies.

Sub-Assemblies

Although not equipped with time-saving devices equal to the rubber-veined fixtures, the other assembly departments turn out glider parts with surprising rapidity. Among these are the fairing and floor-building departments.

In the Fairing Department, skilled wood-workers assemble fairing for the nose and tail of the glider. They also make seats for pilot and co-pilot, glider landing skids, a folding seat for the center section of the plane and the lower section of the glider's nose. Complete assembly of the lower nose is made on wood fixtures manufactured at the Iron Mountain plant. Parts going into the nose—spruce stringers, bulkheads, ribs and beading strips—are cut and shaped by woodworkers in this department. Lamination also is done there.

The spruce and plywood tail of the glider also is constructed in the Fairing Department, as are bulkheads for center and rear sections of the troop transport. Other glider accessories turned out are plywood data cases, floor-like foot rests and toe-guards for pilots, and window frames for the glider nose.

Most burdensome, perhaps, of the sub-assemblies is that concerned with making of the glider floor. Built of plywood and spruce, the hollow floor consists of 216 boxlike cells contained within a reinforced spruce framework. Honeycombed to achieve the maximum

amount of strength with the least possible weight, the mahogany plywood floor, weighing less than 300 lb, can withstand the pressures of combat use. The floor is 13 ft 6 in. in length and 6 ft 2 in. in width.

The gluing operation on this assembly is a tedious one, at first necessitating the use of 420 wooden clamps. These gripped the cells together until the glue dried. Later, Ford engineers cut the drying time by hours through the invention of electric clamps which applied both heat and pressure. This department also assembles the glider's hollow boxlike seats, each capable of accommodating three fully-equipped soldiers.

Fuselage

Plywood lower noses, tail assemblies, glider floors and all fairing are conveyed, on their completion, from Building No. 3 to the two renovated, corridor-like kilns in the rear of Building No. 1. In these two rooms the gliders first take shape, then are moved on to the last stages of assembly. Before being delivered to the kiln workshop, the glider floors are routed through the adjoining paint room, where the upper surfaces are doped and the bottoms covered with glider fabric.

Also delivered to the one-time kilns are the steel fuselages, which have been built by welding together three sections—the nose, which is hinged to the center section so that it can be raised to permit unloading the glider quickly; the center section, which forms the main and broadest part of the fuselage; and the tail, on which dorsal fins, rudder and other empenage parts are mounted on the final assembly line. Due to the lack of special steel-making facilities at the Ford woodworking plant, the steel fuselage sections are manufactured under Ford contract at the plant of the Lloyd Manufacturing Co., Menominee, Mich., not far distant from Iron Mountain.

Equipping the center section, workmen bolt the floor into place, fit in top bulkhead fairing of spruce and plywood and then attach landing skids and shock absorbers. A cable, used to keep a steady tension on shock absorbers, is run from each short ski-like skid. Pulleys and hardware also are installed. The rear of the center section is furnished with L-shaped spruce and plywood bulkheads into which the rear tubing fit. Similar bulkheads are attached to the front of the center section to serve the same purpose.

Bulkheads fitted into the fuselage are made of spruce and plywood. The cross members used to hold the line of the fabric on the upper part of the center section are made of strips of spruce, $\frac{3}{8}$ in. by $\frac{3}{8}$ in., and sides of plywood, $\frac{1}{16}$ in. in thickness. The L-

shaped bulkheads consist of two sides of plywood, $\frac{1}{8}$ in. in thickness, and strips of spruce. Emergency door frames and service door frames are clamped to the steel tubing. Under the service doors, solid spruce filler blocks, $\frac{3}{8}$ in. by $1\frac{1}{2}$ in., are screwed in to increase strength of the frames. Fairing then is fitted into the fuselage, running from the end bulkheads to the door frame, and from door frame to front bulkheads. Fairing strips of solid spruce, $\frac{3}{8}$ in. by 1 in., are used.

Thirteen safety belt clamps then are attached to the tubing, seven on one side, six on the other. Seat backs also are installed at this time. These are made of plywood sheets and spruce strips. A triangular plywood and spruce support for folding seat is attached near the service door on left side of glider. Spruce fairing is added to the rear end of floor to hold fabric in shape. Two screw supports are inserted on left side of plane near service door to hold a data box.

The tail section, made in the Fairing Department in Building No. 3, is fitted on the tapering end of the tubular tail section by another crew of workmen. It is bolted to metal brackets and tied by 85-test string, which is later shel-lacked. Half-inch friction tape is wound around four points on each side to strengthen the union.

Long fairing is then fitted into the steel framework of the tail section. Ends of these are glued in and strengthened with plywood gussets glued over the joints. Stringers also are installed on each side near the bottom of the section. Aluminum supports are attached to the tubing and bolted to the stringers. Three other stringers are run along the top to serve as fabric supports. These are attached to finger-like aluminum supports, which in turn are taped to tubing.

A separate crew of workmen prepare the nose for the final assembly line, installing the lower plywood nose fabricated in Building No. 3. This is attached to the tubing framework with bolts and brackets. Clamps also are attached to hold lower windshield in place. Fairing work is completed with the installation of two pilot seats, pilot floor boards, a data box, lengthwise fairing and L-shaped bulkheads.

Doping

Moved from the Fairing Department, the three fuselage sections are transferred over a conveyor system to the adjoining doping room in the rear of Building No. 1. This board room was occupied in peacetime days by varnish and station wagon upholstery departments.

The doping room is the palm of a mass-production plan laid out like an outspread hand. Three fingers are represented by Building No. 3, from which come the wings and the empen-

(Turn to page 64, please)



Sky Hooks

for man-made birds

Just a metaphor, of course! But this Denison HydroOILic Test Stand is the nearest thing to a "sky hook" in helping man-made birds to keep from faltering in flight.

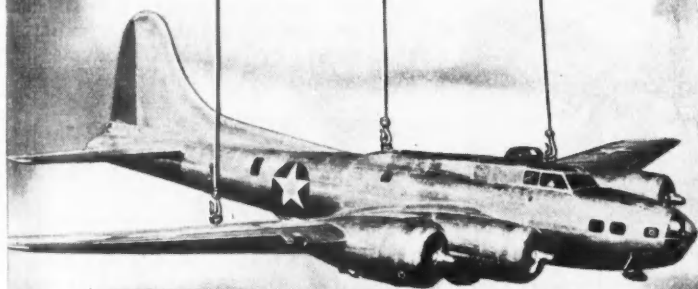
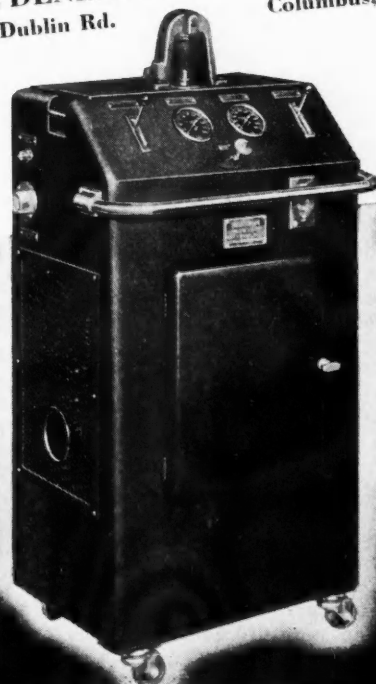
It makes a quick test—on the ground—of the way spark plugs are going to perform in the air. Faulty plugs are spotted before they cause trouble.

This is only one way Denison equipment is serving aviation. Other HydroOILic Test Stands check the action and control of ailerons, rudders, brakes, bomb bay doors and landing gear . . . the performance of magnetos . . . the feathering action of propellers.

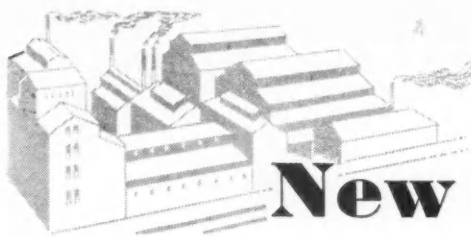
HydroOILic Equipment is also doing vital work in other fields. Its oil-hydraulic control of power and motion is being applied to operations from one end of industry to the other—with greater flexibility and exactness as the result.

If this suggests an answer to some of your problems, we invite you to take it up now with our engineers.

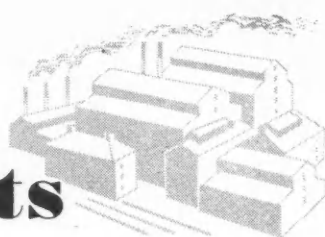
THE DENISON ENGINEERING CO.
1178 Dublin Rd. Columbus, Ohio



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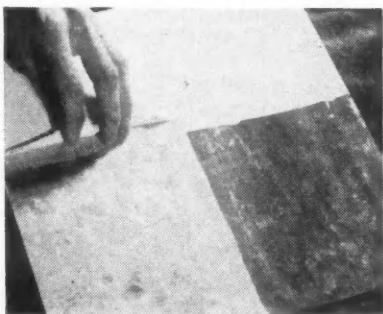


New Products



Redi-Paint Prepares Galvanizing for Paint

Turco Redi-Paint, a recent development of Turco Products, Inc., Los Angeles, Cal., passivates, or renders inactive, the surface of galvanized metal to prevent chipping or peeling of paint. In addition, it replaces the slick, oily surface typical of galvanized metal with a roughened surface to form a



Section at right shows dark color of Turco Redi-Paint and paint adhering firmly to treated area

tight bond with the paint. A feature of Redi-Paint is color control; a dark tint develops on areas properly treated, leaving the untreated areas conspicuously bright. It can be applied by hand or by tank immersion. When applied by hand, the Redi-Paint is wiped on full strength, or diluted with water. The surplus liquid is removed with a squeegee when the proper color develops and the surface is then dried with clean, dry cloths.

New Method Cleans Spark Plug Shells

A method for cleaning aircraft spark plug shells faster and safely, using Turco Type X and Turco De-Scaler as the chemical compounds, has just been officially approved by the BG Corporation, makers of BG spark plugs, according to Turco Products, Inc., Los Angeles, Cal.

The new Turco method removes all oil, grease, lead and carbon deposits and leaves the spark plug shells chemically clean quickly, safely and economically. Drag-out losses per gross of shells, using the Turco method, are only about .06 gallons of solution or .03 pounds of Turco Type X.

Briefly, the new procedure involves a one-hour submersion of the spark plug shells in a boiling 8 ounce per gal-

lon solution of Turco Type X; a thorough water rinse; a one-half hour soak in a 50-50 solution of Turco De-Scaler and water; a second water rinse, and then a neutralizing dip into the Turco Type X solution. Shells should then be dipped in oil to prevent rusting. Where re-blueing is desired, this step precedes the oil dip.

Plastic Sealed Identifying Devices

Plastic sealed arm bands, identification badges, tool checks, and similar identifying devices are being offered by the Hollywood Athletic Co., Los Angeles, California.

These items with company names and addresses imprinted, or in stock designs, are available in a variety of



Plastic Sealed Arm Band Made by Hollywood Athletic Co.

sizes, shapes, and colors. Completely waterproof, they are also practically soilproof and extremely light yet strong and durable. They provide a convenient means for identifying department employees and key people such as inspectors and expeditors.

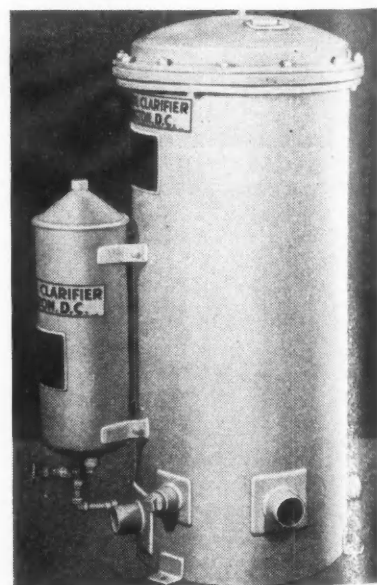
Impregnated Plywood Made by New Process

Pluswood, a product of Pluswood, Inc., Oshkosh, Wis., is a resin impregnated plywood, heated by high electrostatic frequency waves and simultaneously compressed under heavy pres-

sure. The new process is said to reduce the resin content of the wood 100 per cent and to greatly increase its weight-strength ratio. Natural Pluswood is a rich dark brown with a high, permanent gloss finish showing wood grain. It weighs half as much as aluminum and one fifth as much as steel. It can be sawn, drilled, turned, threaded, milled and tapped. Although wood, it is highly resistant to decay, is impervious to mild acids, and will not support combustion. These qualities, in addition to its tensile strength (parallel laminated in fibre direction) of 32,000-40,000 lbs. per sq. in., make this alloy wood particularly suitable for use in aircraft and automotive equipment.

Briggs 100% Flow Filter-Clarifier

The Briggs Clarifier Company, Washington, D. C., has just brought out a new 100 per cent Flow Filter-Clarifier which is available in a range of sizes having capacities of 5 to 200 gallons per minute. The filter section is equipped with long fibred cellulose cartridges, and is designed to take the complete flow of the system, thus removing all solid contamination. The clarifier section is designed with sufficient capacity to continuously maintain the oil free of oxidation products, and may be operated at will.



Briggs 100% Flow Filter-Clarifier

PART of the War IS OVER



Part of the war . . . the terrific battle to quickly build up production

capacity of war materials . . . is over. The productive capacity of many new plants has far exceeded early estimates . . . as a result the inefficient producers will be curtailed and competitive conditions will return.

And competition means that frozen designs must be thawed—developments for the future must be brought nearer the production stage. Builders must be able to offer better machines

—and in some cases must use less critical materials.

Vickers Hydromotive Controls provide a most important design resource for improvement of machines in the important fields of better control—higher production rates—wider utility—greater safety and the elimination of operational difficulties.

You will find it advantageous to have a Vickers Application Engineer discuss with you the possibilities of improved machine controls.

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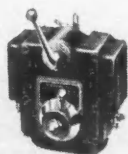
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**Representative of More than 5,000 Standardized Vickers Units
for Every Hydraulic Power and Control Function**



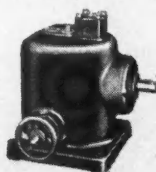
CONSTANT DELIVERY
PUMPS



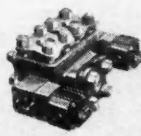
CONTROL
ASSEMBLIES



FLUID
MOTORS



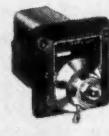
VARIABLE DELIVERY
PUMPS



DIRECTIONAL
CONTROLS



PRESSURE
CONTROLS



VOLUME
CONTROLS

UAW-CIO Seeks Corporation-Wide Wage Stabilization Agreement

In Its Present Negotiations with GM, the Union Wants Uniform Rates Regardless of Local Labor Conditions

Efforts of the UAW-CIO to obtain industry-wide wage agreements on the basis of equal pay for equal work have met a setback. The National WLB has refused to raise the wage rate at three Chevrolet plants in Buffalo and North Tonawanda, N. Y., to equal the rates paid in Detroit plants for similar job classifications. Instead, the WLB set the Buffalo rates five cents below those for General Motors plants in the Detroit area, although it made the 5-cent differential flexible. It maintained that a raise in rates would tend to unstabilize the wage situation in the Buffalo area, where Chevrolet rates are among the highest. The WLB held that rates paid in other plants producing Pratt & Whitney aircraft engines also could be a factor in determining the Buffalo rates. In its present negotiations with General Motors over renewal of its contract, the UAW-CIO is seeking a corporation-wide wage stabilization agreement to set up uniform rates in disregard of local labor conditions. If the WLB is consistent, this demand is likely to be denied.

In a rather unprecedented action, Local 594 of the UAW-CIO has disciplined 179 of its members at the Yellow Truck & Coach Mfg. Co., Pontiac, by fining them each \$5 for participating in a wildcat strike last March 17. This is the first mass disciplinary action ever taken against its members by a local of the union. The fines, totaling \$895, are equivalent to about half a day's pay for each worker at average base rates. Two other workers, previously fired by the company for their participation in the strike, were given four-week disciplinary layoffs on recommendation of William E. Simkin, special one-man investigator for the Detroit regional WLB. Simkin also had recommended the disciplinary action against the other participants by the local.

The March 17 strike was precipitated when an employee was given a three-day disciplinary suspension for smoking on the job. Hiring of women employees and fear by some workers that they would be transferred to lower paying jobs also figured in the dispute, which involved less than 200 but made 2,000 workers idle. After

the one-day strike the Yellow Truck management petitioned the WLB for a review of the maintenance of membership clause in the union's contract and asked for its forfeiture because it declared that the union had violated the board's conditions in granting the clause in the first place. In its decision of Dec. 16, 1942, granting maintenance of membership, the WLB made that clause provisional upon the union's good behavior and avoidance of work stoppage. In reporting to the Detroit regional board on the March 17 stoppage, Simkin said that if the union disciplined its members, he felt the maintenance of membership should be maintained. The four industry

members of the Detroit board dissented, saying, "The evil consequences to war production in this plant of continued contempt for discipline and obligations to their unions that employees have shown are too serious to be met by the equivalent of a slap on the wrist."

A protest walkout by less than 200 tool sharpeners and toolmakers closed the plant of the Saginaw Steering Gear Division of General Motors for 36 hours, making idle 5,000 employees engaged in the manufacture of Army carbines and machine guns. Two workers were fired and seven others suspended for from one to two weeks as a result of the dispute, which was referred to mediation by GM and UAW-CIO representatives. The tool sharpeners and toolmakers walked out because of a new swing shift arrangement which would compel some of them to work on the night shift. GM officials said this was necessary in order to keep the plant running on a 24-hour, 7-day basis to meet increased Army

(Turn to page 58, please)

Steel Allotments for Civilian Products Often Misinterpreted

Capacity of the Finishing Departments of Steel Mills Is Fully Allotted for the Third Quarter of the Year

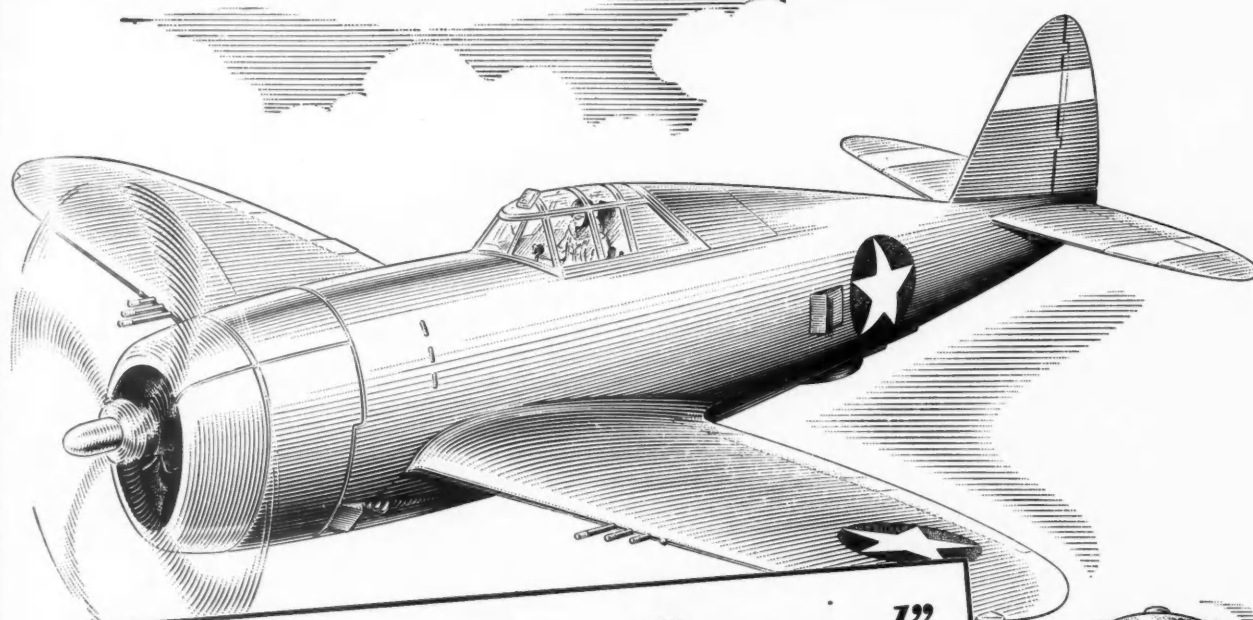
By W. C. Hirsch

Every time that the War Production Board's Office of Civilian Requirements makes known its intention to permit the manufacture of a limited quantity of this or that essential item, stocks of which are near the exhaustion point, it is misinterpreted in some quarters as indicating early release of an important part of the country's steel-making capacity for other than war requirements. The other day, OCR hinted that manufacture of possibly a million electric irons and a few other small domestic appliances would be sanctioned, and forthwith a large scale release of steel for non-war purposes was read into this routine action. Some day the switch to peacetime needs is bound to come, but for the present not only is every pound of steel that the mills can produce urgently needed in the war effort, but the "Steel for Victory" drive for 2,000,000 tons over and above the expected mill output in the second half of the year is being carried on with undiminished energy.

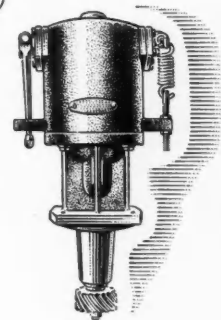
That changes in the character of the weapons and armaments required for

the next phase of the war are reflected in modifying the emphasis on some descriptions of steel is obvious, but more often than not changes in design cause alterations of specifications rather than out-and-out shifts from one category of armament to another. So steel demand of tank makers continues along unchanged lines in spite of lay strategists' opinion that tanks will not play as important a part in future battles as they have heretofore. Capacity of finishing departments of steel mills is fully allotted for the third quarter, with several booked clear to the end of the year. Some sizes of cold-finished and ordinary carbon bars are more difficult to obtain, and hot-rolled sheet shipments frequently fail to come up to buyers' expectations in point of promptness and quantities. Volume of business of non-integrated sheet mills is restricted by tightness in the monthly allotments of sheet bars. Announcement by one of the large rolling mills of the perfecting of a method for rolling airplane propeller steel at an impressive saving in material and machining come as a re-

(Turn to page 62, please)



The Fighter Plane "Borrowed" Something Old from the Governor



IT MAY BE surprising to learn of vehicle engine governors having something in common with modern combat planes. In governor design, the problem was one of space limitations...and, of course, precision. So designers selected the Torrington Needle Bearing since it combined, happily, the necessary small size with a friction coefficient low enough to assure a high degree of accuracy in governor operation.

Builders of fighter planes, on the other hand, were confronted with an entirely different set of problems. A bearing for manual control mechanisms must not only conserve space and weight, but respond instantly—time after time. Yet strangely, or perhaps not so strangely, military aircraft manufacturers found what they, too, were looking for in the Needle Bearing. And other features as well, which came in mighty handy as the war took increasingly to the air.

In addition to this unique anti-friction bearing's compact design there was its effective lubrication, which helps keep 'em flying miles and often whole continents from maintenance stations...

high unit capacity, meeting the rigid load and weight requirements of these fast, maneuverable aircraft...ease of operation, giving our pilots one more

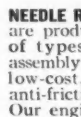
important edge in aerial combat...and ready availability—a vital factor helping to maintain and speed up our plane production.

NEEDLE BEARINGS— ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.



NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.



NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.



DOES THIS SUGGEST TO YOU POSSIBILITIES for adapting the Needle Bearing to your postwar designs? The people you serve are going to want, in their own products after Victory, the revolutionary principles that have improved performance and cut costs in war production. And the Needle Bearing offers all of them—light weight, compact design, infrequent lubrication, dependable operation, plus installation ease unique in an anti-friction bearing. For preliminary information, write for Catalog No. 107 which lists sizes, ratings and typical applications. Then let Torrington engineers help you work out whatever specific service problems may develop.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend, Ind.

Makers of Needle Bearings and Needle Bearing Rollers

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TORRINGTON NEEDLE BEARINGS

Subcontractors Furnish Many Parts to Large War Producers

General Motors Employs 18,735 Different Sources for Parts and Material, Chrysler Has 8079 Subcontractors

Although large war producers like General Motors and Chrysler are regarded as fairly self-sufficient with their multitude of plants and divisions, they depend upon thousands of suppliers and subcontractors to furnish parts for the munitions they are turning out. A recent GM survey revealed that the 37 manufacturing divisions and operating units of that corporation employ 18,735 different sources for parts and material. A similar Chrysler survey showed 8,079 individual subcontractors, a 425 per cent increase over the 1,540 companies that sold to Chrysler in peacetime. The 8,079 war-time subcontractors are located in 856 cities in 39 states. Fifty-nine per cent of them are relatively small business concerns, 19 per cent are medium-sized and 22 per cent are large organizations. Among GM suppliers, 74 per cent are small firms employing less than 500 persons and 58 per cent of these small firms have less than 100 employees.

The aerial torpedo made by the Pontiac Motor Division of GM contains 5,112 parts, of which 110 are made by Pontiac, three by other GM divisions and 4,999, or 98 per cent, by outside subcontractors. Ninety-nine per cent of the 267 parts going into the 37-mm. aircraft cannon made by the Oldsmo-

bile Division are furnished by subcontractors, only three being made by Olds. Sixty per cent of the 3,719 parts for the M-4 medium tank made at the Fisher Body Tank Arsenal come from outside the corporation, Fisher Body providing 392, other GM divisions supplying 1,103 and outside companies furnishing 2,224.

Four hundred and forty-six or 88 per cent of the 507 parts comprising the Oerlikon 20-mm. anti-aircraft gun made by Pontiac are manufactured by outside sources. In the .50-caliber machine gun made by AC Spark Plug Division, there are 292 parts, of which 137 are made by AC, 28 by other GM divisions and 127 or 43 per cent by outside companies. Chevrolet Motor Division utilizes outside companies for 61 per cent of the 972 parts that make up a Pratt & Whitney 1,200-hp. aircraft engine. Chevrolet makes 37 per cent or 362.

Subcontractors furnish 60 per cent of the 32,703 parts going into 21 major war products of the Chrysler Corp. In the M-4 medium tank, 72 per cent of the 4,537 parts come from outside sources. Seventy-five per cent of the 406 items making up the gyro-compass manufactured by the Dodge Division are supplied by subcontractors. The Dodge 4x4 military truck contains 726

Dodge-made parts but 1,127 parts, or 68 per cent, come from suppliers. Sixty-five per cent of the 516 parts in the Chrysler 8-cylinder marine engine are provided by other companies. Approximately 50 per cent of the 466 parts in the Bofors 40-mm. anti-aircraft gun for the Army are supplied by subcontractors. Of the 11,542 parts making up a Martin B-26 bomber fuselage, 5,881, or 51 per cent, are manufactured for Chrysler by outside companies. There are 3,621 parts in a Navy dive bomber wing assembled by DeSoto, of which 42 per cent are bought from suppliers.

Another U. S. liquid-cooled aircraft engine is being flight tested, with the possibility that it may go into production. (Turn to page 60, please)

New Car Stockpile Dangerously Low

The nation's stockpile of new passenger cars, as of May 31, 1943, consisted of 155,394 vehicles. Unless authorization is granted for the production of additional new cars, this stockpile must last the civilians and government agencies not only for the duration of the war but for also some time after the war until the car factories can reconvert to their peacetime production of cars and trucks.

On Feb. 11, 1942, the nation's stockpile consisted of 520,793 new passenger cars and since that date 365,391 have been purchased by civilians and government agencies, according to figures recently released by the Automobile Rationing Branch of the Office of Price Administration. Monthly and cumulative totals of these sales of new cars follow. These data constitute a revision of those data published in the Statistical Issue of AUTOMOTIVE and AVIATION INDUSTRIES, March 15, 1943.

The following table shows the number of new automobiles rationed since the start of the rationing program. Previous monthly data covering certificate issuance has been adjusted for unused certificates and for the purchase of used 1942's.

Month	Total Number of New Cars Purchased By Civilians and All Government Agencies and Bus Conversions	Cumulative New Car Purchases and Bus Conversions
February, 1942	28,478*	28,478
March	15,397	43,875
April	24,350	68,225
May	30,259	98,484
June	23,434	121,918
July	25,605	147,523
August	27,911	175,434
September	19,068	194,502
October	14,123	208,625
November	9,973	218,598
December	34,374**	252,972
January, 1943	11,328	264,300
February	11,776	276,076
March	29,058	305,134
April	31,357	336,491
May	28,908***	365,399

* Represents new automobiles acquired through clearance statements by persons who established bona fide contract for automobiles before January 1, 1942.

** Includes automobiles purchased by Army and Navy during December, 1942.

*** Estimated



Assembling Military Motor Trucks in Australia

These International Harvester Trucks are used in considerable quantity by the Australian Army and by the American Armed Forces in the Southwest Pacific combat area. They are being assembled at the International Harvester Company of Australia, Pty. Ltd., Mel-

bourne. The severe conditions under which military trucks must operate are intensified in the Australian bush, so trucks are equipped with special wheels and tires, shock absorbing springs and other protection against the abnormally rough usage they will receive.



One way trip...to death!

A DEVASTATING MIGRATION occurs at irregular intervals in Norway. Countless hordes of rodents, known as "lemmings," emerge from nowhere. They seem to be led by some invisible Pied Piper.

They travel in parallel lines three feet apart, straight through hay and corn stacks, across mountains instead of around...on and on to the brink of the sea. But they don't stop there. They swim straight to a point miles out in the ocean. Then they swim in circles until they drown!

Several theories have been advanced about the fatal pilgrimages of lemmings, but the most likely one is that they are searching for an island which no longer exists. It is an age-old custom: blindly attempt-

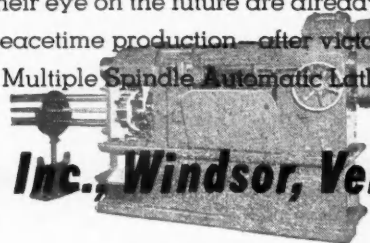
ing to live by landmarks which disappeared long ago.

The custom is represented by men who hooted at automobiles—by the men who laughed at Wright—and by the men who said democracy couldn't compete with a dictatorship. Happily, those men can be belied by a reliable index—that of the machine tool industry.

We gave Germany a 7-year head start, and passed her in about a year. For every one machine tool produced today by the Nazis, **we are now producing 5.**

The Conomatic, a key machine of peacetime industry, is well known to the production men of America. Those with their eye on the future are already thinking in terms of peacetime production—after victory is won—with Cone Multiple Spindle Automatic Lathes.

CONE Automatic Machine Company, Inc., Windsor, Vermont



August 1, 1943

When writing to advertisers please mention AUTOMOTIVE and AVIATION INDUSTRIES

PUBLICATIONS

The Torrington Co. has published a booklet, **Needle Bearings, All Types—All Sizes**. Each type is illustrated and a full page of description is included. The Torrington Company has also issued a booklet—**Engineering Revisions Applicable to Needle Rollers**, applying to material previously published in catalogs Nos. 30 and 31 and Bantam Bearings Corp. Catalog No. 14.*

Tinnerman Products, Inc. has issued a 20-page illustrated aircraft summary catalog showing fifty new **speed nut** and **speed clip** applications designed to cut assembly time and save weight. Included are engineering data showing how speed nuts conquer vibration loosening, and illustrations of retainer rings, speed nut strips, latching nuts, cable clips, speed nuts for plywood, etc.*

A new folder has been published by American Chemical Paint Co. on Lithoform, a non-inflammable liquid chemical for coating galvanized iron and other zinc or cadmium surfaces before painting.*

The fundamental principles of the six basic ways in which electronic tubes function are explained in a new 36-page booklet, **The ABC of Electronics at Work**, announced by Westinghouse Electric & Mfg. Co. Also published by Westinghouse is a new 44-page booklet, **Electronics at Work**, describing and illustrating electronic applications in industry, in the war, in medicine and the home.*

American Solder & Flux Co. announces the publication of Bulletin No. 52, describing **AMCO Galvanizing Compound**, which meets government specifications and is in use for on-the-spot repair of galvanized surfaces damaged during fabrication or assembly.

Keystone Carbon Co. has released a customer service feature, lists containing pertinent information on **Selflube Porous Bronze Bearings**.*

A 6-page bulletin, GT-157, on how to reclaim carbide tipped cutters and worn out HSS cutters, has been issued by Carboly Co., Inc.*

Sterling Tool Products Co. has issued a new two-color folder, **Faster Production For War Industries**, describing and illustrating the Sterling 1000 electric portable sander. Included in the folder are specifications for the sander.*

In commemoration of the dedication of its new Research Laboratory, The Goodyear Tire & Rubber Co. has published a book, **The Goodyear Research Laboratory**, written by David Dietz and attractively illustrated by Theodore Kautzky. Chapters are devoted to the story of rubber, the story of the Goodyear company and its research achievements. Distribution of the book is limited.*

A new, 16-page illustrated bulletin, **Flexible Bag Molding of Curved Plywood**, has been prepared by Resinous Products and Chemical Co. It discusses, among other things, the special properties required of adhesives in bag molding. A large section of the bulletin is devoted to a complete coverage of methods of applying flexible pressure to molded plywood. Included also is a bibliography covering some of the more important references to technical publications.*

Plomb Tool Co. has published a booklet called **These Are Your Weapons**, which gives fourteen ways to increase your war production. The booklet is dedicated to the workers on the American production front.*

Acme Industrial Co. has prepared a two-color, 12-page booklet on light wave measurement. It contains various descriptive charts, illustrations, diagrams and detailed instructions designed to simplify the understanding of light wave measurement.*

A new bulletin, describing the use of the **Brown Radiamatic Pyrometer** with a sili-manite target tube for controlling the temperature of high-speed salt baths, has been

published by Brown Instrument Co. Sections of the bulletin are devoted to the use of salt baths, heating principles and control problems encountered in this application.*

The DeVilbiss Co. has developed a new **Compressor Check Chart**, a handy, condensed service manual designed to help keep the present supply of compressors in good condition until new ones are again available.*

Porter-Cable Machine Co. has issued an attractive booklet, **A New Precision Machining Method**, describing its new precision method of wet belt machining. In addition to the various surfacing machines, illustrations, descriptions and specifications are given for grinding and sanding machines, milling machine attachments, shapers and Speedmatic saws built by the company.*

*Obtainable by subscribers within the United States through Editorial Dept. Automotive and Aviation Industries. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.



Awards

Names and winners of Army-Navy "E" awards in or allied with the automotive and aviation industries, announced since the July 15 issue of *Automotive and Aviation Industries* went to press.

CANNON ELECTRIC DEVELOPMENT COMPANY, Los Angeles, Cal.

ETHYL CORPORATION (two plants).

METRO TOOL AND GAGE COMPANY, Chicago, Ill.

MONSANTO CHEMICAL COMPANY, Plastics Div., Springfield, Mass.

THE NATIONAL CARBON COMPANY, INC., Niagara Falls, N. Y.

REPUBLIC AVIATION CORPORATION, Farmingdale Plant, Farmingdale, Long Island, N. Y.

THE WIREMOLD COMPANY, West Hartford, Conn.

MEN

Palmer M. Craig, for the past two years chief engineer in charge of radar and radio communications equipment development, has been named chief engineer of the Radio Div., Philco Corp.

Frank C. Mahnke, Jr., has been appointed advertising manager for All-Steel-Equip Co., of Aurora, Ill.

Paul M. Dollard, formerly secretary-treasurer of Adel Precision Products Corp., Burbank, Calif., has been elected executive vice-president and secretary of the corporation. Svend Amidsen, formerly assistant treasurer, has been made treasurer.

The appointment of E. J. Sanders, as vice-president and director of Kontrol-Fan, Inc., Glendale, Calif., has been announced. Mr. Sanders will also act as chief engineer.

Worthington Pump and Machinery Corp. has announced the appointment of Marcello A. King as executive engineer of its Moore Steam Turbine Div., Wellsville, N. Y.

Warner L. Jones has been made division manager of the Louisville, Ky., division of Consolidated Vultee Aircraft Corp. He succeeds W. E. Burdick.

William A. Lippman, Jr., and Ralph Oursler have joined the Aircraft Div. of Evans Products Co., Detroit, as Skyloader Service and Training Engineers.

John W. Thompson, for the past four years Cleveland District Representative of The Carpenter Steel Co., has been appointed assistant manager of Alloy Steel Sales, with headquarters in the Reading, Pa., office of the company.

The appointment of Victor H. Mantz, as assistant to E. J. Hanley, secretary and treasurer of the Allegheny Ludlum Steel Corp., has been announced.

Wallace W. Leipner has been appointed acting chief engineer of the American (Turn to page 58, please)

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Little net change in general business activity during recent weeks is indicated. The New York Times seasonally adjusted index for the week ended July 10 stands at 137.7, as against 137.9 for the preceding week and 126.5 a year ago.

Seasonal slackening of retail trade is evident. Department store sales reported by the Federal Reserve Board for the week ended July 10 were 1 per cent below the corresponding level last year, this drop contrasting with a gain of 40 per cent shown for the preceding week. Sales for the four weeks ended on that date were 21 per cent larger than a year ago, and the total for the year to date is 14 per cent above the comparable 1942 figure.

Railway freight loadings in the week ended July 10 totaled 808,630 cars, showing a decline of 5.1 per cent from the figure for the preceding week and 5.4 per cent from that for the like period of last year.

Electric power production during the same period declined, in contrast with the usual seasonal trend, but was 14.3 per cent greater than a year ago. For the preceding week a comparable gain of 20.1 per cent was reported.

Crude oil production during the week ended July 10 averaged 4,090,250 barrels daily. This figure is 82,450 barrels above that for the preceding week and 432,850 barrels greater than production a year ago. It is 5 per cent below the output recommended by the Petroleum Administration for War.

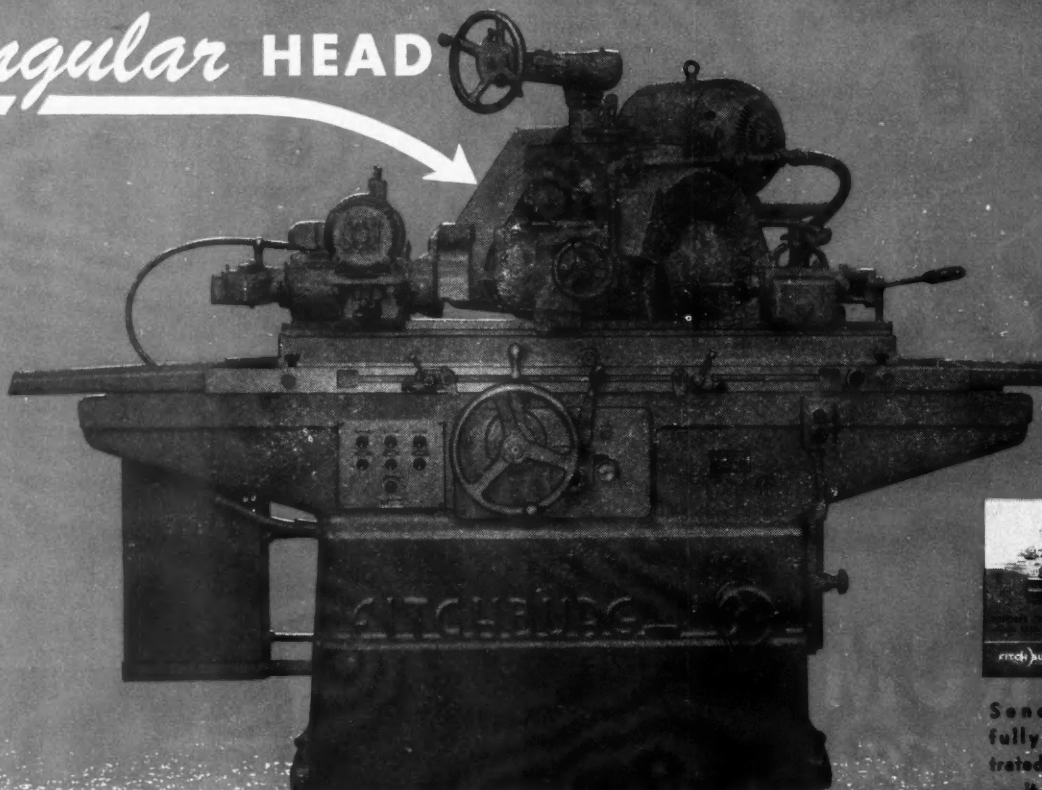
The production of bituminous coal in the week ended July 3 was officially estimated at 10,350,000 net tons, as compared with 4,610,000 tons a year earlier and 8,172,000 tons a year ago.

Engineering construction contracts awarded during the week ended July 15 amounted to \$104,105,000 according to *Engineering News-Record*, more than double the figure for the week before but 40 per cent below that for the corresponding period last year. For 1943 to date, the total is 63 per cent less than the comparable sum in 1942.

Professor Fisher's index of wholesale commodity prices for the week ended July 16 advanced three fractional points from the preceding level, to 111.1 per cent of the 1926 average, as against 108.2 a year ago.

Member bank reserves increased \$152,000,000 during the week ended July 14, mainly because of reductions in Treasury deposits with the Federal Reserve banks. Excess reserves rose \$80,000,000 to an estimated total of \$1,310,000,000. Business loans of reporting member banks increased \$23,000,000 during the preceding week but stood \$1,235,000,000 below the total a year earlier.

A GENERAL PURPOSE CYLINDRICAL GRINDER WITH ADJUSTABLE *Angular* HEAD



Send for
fully illus-
trated folder
— it will be
mailed free.

This latest of Fitchburg plain cylindrical grinders, the Type "C" Angular Head Grinder, is designed to handle a wide range, and a number of types of jobs. It will cut grinding time and grinding costs.

The Fitchburg Type "C" Angular Head Grinder is adjustable. It has a standard Wheelhead Unit mounted so that it may be located to grind from 0 degrees to a 45-degree angle. The Bowgage head can be swivelled to various positions for standard plain cylindrical grinding, providing a wider range of grinding.

The Fitchburg Type "C" is completely automatic, the workhead is adjustable for various lengths of work and the work spindle can be equipped for single or variable work speeds.

The Fitchburg Type "C" Grinder is designed to meet wartime production speed and maintain highest efficiency. In every detail it meets all the requirements of plain cylindrical and taper grinding — in large or small lots of work, with assured accuracy and fine finish, at low cost. Write for complete information today.

FITCHBURG GRINDING MACHINE CORP.
FITCHBURG, MASSACHUSETTS, U.S.A.

Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

Sloan Addresses General Motors Club in Chicago

At a recent meeting of the General Motors Club of Chicago, Alfred P. Sloan, Chairman of the Board of General Motors, discussed the work of General Motors in the war effort and the post-war problems facing the organization. It would seem that the earliest reasonable date, assuming all conditions favorable, to expect new car production is four months after the cessation of war goods manufacture. It should later be possible, with the demand for new cars, and with the Corporation's greatly increased facilities,

again assuming an ample supply of materials and a reasonable economic environment, to step new car production 50 per cent from the pre-war peak of 10,000 up to 15,000 cars and trucks a day.

Mr. Sloan commented on the pre-war tendency for cars to become larger, and, as specified by the buyer, somewhat more expensive from year to year. This was, of course, to some extent a matter of free choice on the part of the customer; nevertheless this point must be kept in mind for the future.

A period of good business lasting for at least five years seems in the offing the coming of peace, in Mr. Sloan's opinion.

New Airplane Landing Gear

The long-sought "airplane for everybody" has been brought nearer by a new development in landing gears which is said to greatly assist in landing gently and safely.

According to *Air Force*, the Official Service Journal of the U. S. Army Air Forces—"A racing plane piloted by Steve Wittman, veteran racer of Oshkosh, Wis., gave the army the idea for a new type of leaf spring landing gear for PT-13 and PT-17 training planes.

"The new landing gear has been drop-tested, flight-tested, and approved by the Army Air Forces Materiel Center at Wright Field, and will be installed on 25 training planes for further testing. Although, after looking at the accompanying photograph, it might be suspected that a plane using this kind of landing gear would bounce right back into the sky upon being landed, quite the opposite is true, for when the machine hits the ground, the spring gear spreads out and each wheel serves to dampen the rebound.

"Wright Field pilots, who have tested the spring gear, claim it is superior in every way to landing gears used currently on planes of this type. It shows its mettle particularly in fast taxiing turns. It is softer in taxiing and less



Leaf Spring Landing Gear

stiff when dropped in for a hard landing. There is no rebound tendency when the plane is landed on hard, dry surfaces, and even when landings are made on wet grass or ice, the rebound is negligible. In take-offs, there is no apparent difference from the conventional gear installations.

"The simplicity of the spring gear makes it easy to manufacture. Made from flat, non-critical steel plate stock cut to shape, drilled, and bent to form, it is cheaper to construct than the present strut, and saves many hours of production time. Large-scale production is only a 60-day problem."

The simplicity of the new and improved design is due to the fact that a properly engineered leaf spring, while having ample resilience in a vertical direction, still has sufficient lateral stability to make it unnecessary to use struts to position the landing wheels.

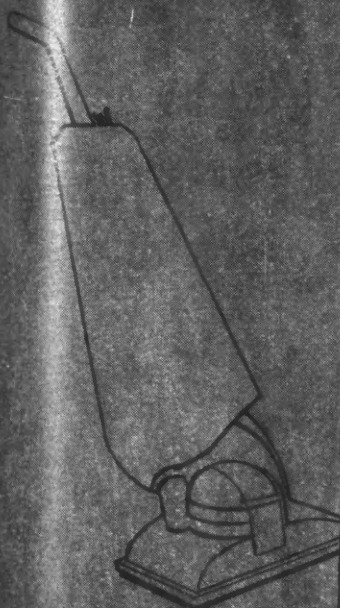
STROM STEEL BALLS
Now at War - Later in Peace

Strom Metal Balls are now being used in the vehicles of war. But in the peace to come, they will again be dedicated to the designing and building of better methods for air and automotive transportation.

Largest independent and exclusive metal ball manufacturer

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VACUUM CLEANERS



TO MACHINE GUNS



TO WHAT



PLAN YOUR DISTRIBUTION SYSTEM

FOR *Quick Production Shifts*

Future demands on your plant are being decided on battlefields thousands of miles away. To meet them, utmost flexibility in production facilities is the order of the day.

Such flexibility depends to a large extent on your plant distribution system. Is it adaptable to quick changes in the nature, density and location of loads?

Westinghouse engineers have helped hundreds of war plants choose the "one best" distribution system for their needs. In each case, increased efficiency and protection against sabotage, with the least use of critical materials—have been the governing factors in the selection.

This broad engineering experience is available to you, to help you better meet today's demands, and get set for the swift changes that may come tomorrow.

For prompt action, call our local office. Or send for the helpful booklet below. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. J-94563

UP-TO-DATE FACTS ABOUT DISTRIBUTION SYSTEMS

Keep up to date on latest plant distribution systems. Send for 24-page Booklet, B-3152, which briefly describes different plant distribution systems, and points out the advantages of each.



Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE



PLANT DISTRIBUTION SYSTEMS

MEN

(Continued from page 54)

Welding & Mfg. Co., Warren, Ohio, the company has announced.

Henry K. Beebe has joined the organization of the Wales-Strippit Corp. as works manager. He was formerly associated with Brewster Aeronautical Corp.

Anthony G. Allison has been appointed director of public relations of the Transportation Association of America.

To promote the use of electronics in industry, Westinghouse Electric & Mfg. Co. has formed an Industry Engineering Group headed by **Gordon F. Jones** and **Carl J. Madson**. **Amos J. Germain** will be in charge of the industrial department activities.

Osborn Manufacturing Co. has announced the appointment of **Arthur M. Penhallow** as

controller. He was formerly associated with the National City Bank of Cleveland. The company has also announced the promotion of **Dewey C. Harvey** to the post of chief plant engineer.

Globe Steel Tube Co. has announced the appointment of **E. Gammeter**, formerly with Carnegie-Illinois Steel Co., as chief metallurgist, with headquarters at Milwaukee. Announcement is also made of the appointment of **C. A. Schroeder** as manager at Cleveland, O.

Sperry Gyroscope Co. has announced the appointment of **J. H. Fountain** as publicity manager in the public information department which is headed by **J. A. Fitz** as director.

William S. Richardson, general manager of the industrial products sales div., The B. F. Goodrich Co., has been elected chairman of the OPA Mechanical Rubber Goods Industry Advisory Committee.

UAW-CIO Seeks Wage Agreement

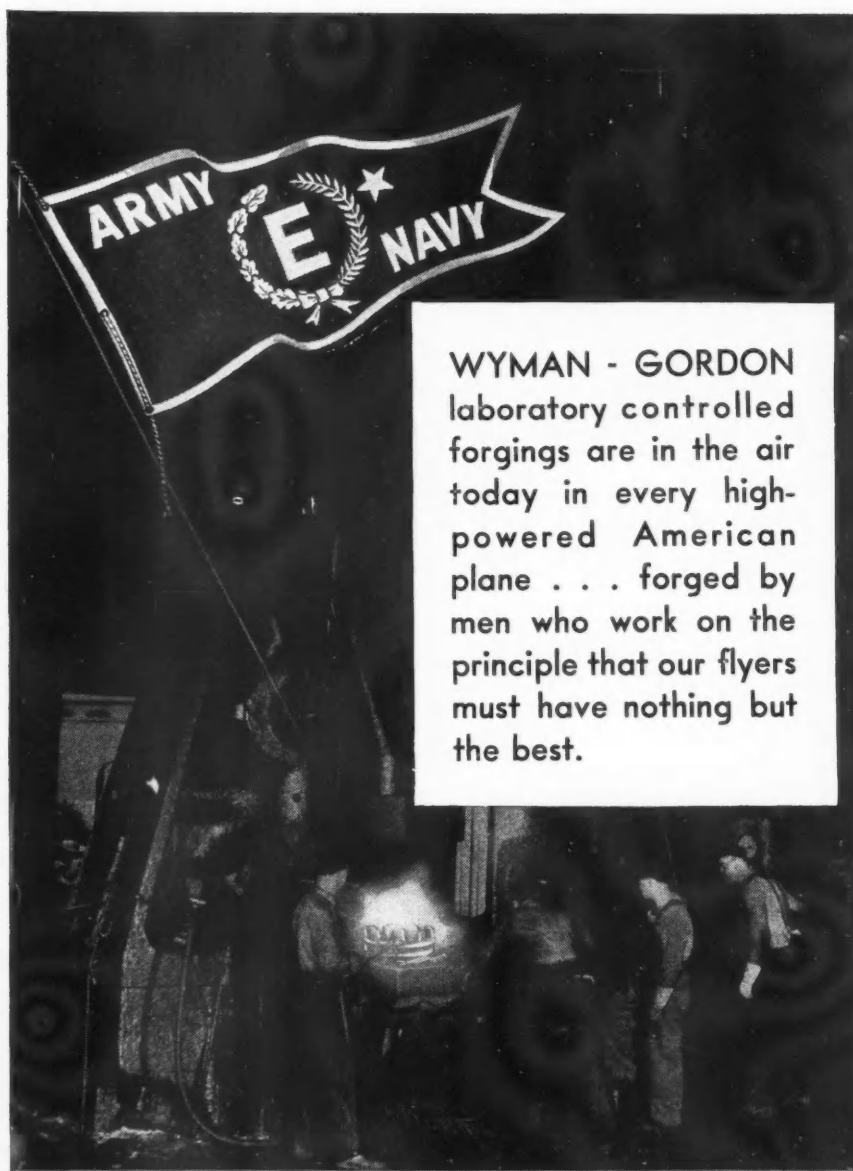
(Continued from page 50)

schedules. The union claimed the swing shift was instituted to cut production costs. Before the mediation conference, **Linwood L. Smith**, regional director of the UAW-CIO, had wired President Roosevelt asking that the government take over the plant. GM charged the union with failure to utilize prescribed grievance procedure.

Balked by the NLRB decision in the Maryland Drydock case denying recognition to unions of supervisory employees, 45 foremen at the Ecorse, Mich., plant of the Murray Corp. of America returned to their jobs after a five-day absence that was termed a strike by the company and a lockout by the foremen. The foremen, members of the Foremen's Association of America which also was involved in the recent foremen's strike at four Ford plants in the Detroit area, ostensibly stayed away from their jobs in protest over the firing of another foreman six weeks previously. However, their real aim evidently was to secure recognition and bargaining rights, which they have been seeking for 18 months from the corporation. Murray officials said production was not adversely affected by the walkout. The foremen also failed to secure any support from the rank-and-file production workers, members of the UAW-CIO.

"The men voted to return to their jobs because of the war effort," asserted **Robert H. Keys**, founder and president of the FAA. "They intend to press their complaints through the legal channels of a government agency instead of holding up the war effort."

Keys has been in Washington recently endeavoring to obtain some reconsideration from the NLRB on its decision in the Maryland Drydock case. Four hundred and fifty foremen at Murray plants in the Detroit area have voted to ask the NLRB and the WLB for authority to take a strike vote in 30 days under the War Labor Disputes Act if their grievances are not settled. However, under the NLRB decision they are denied status as a bargaining agent.



WYMAN - GORDON
laboratory controlled
forgings are in the air
today in every high-
powered American
plane . . . forged by
men who work on the
principle that our flyers
must have nothing but
the best.

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MASSACHUSETTS
DETROIT, MICHIGAN

CALENDAR

Conventions and Meetings

- SAE Transportation & Maintenance Meeting, San Francisco Aug. 19-20
- SAE Nat'l Tractor Mtg., Milwaukee, Sept. 23-24
- SAE Nat'l Aircraft Engineering & Production Mtg., Los Angeles, Sept. 30-Oct. 2
- National Safety Congress, Chicago, Oct. 5-7
- American Welding Society, Chicago, Oct. 18-23
- National Metal Congress, Chicago, Oct. 18-23

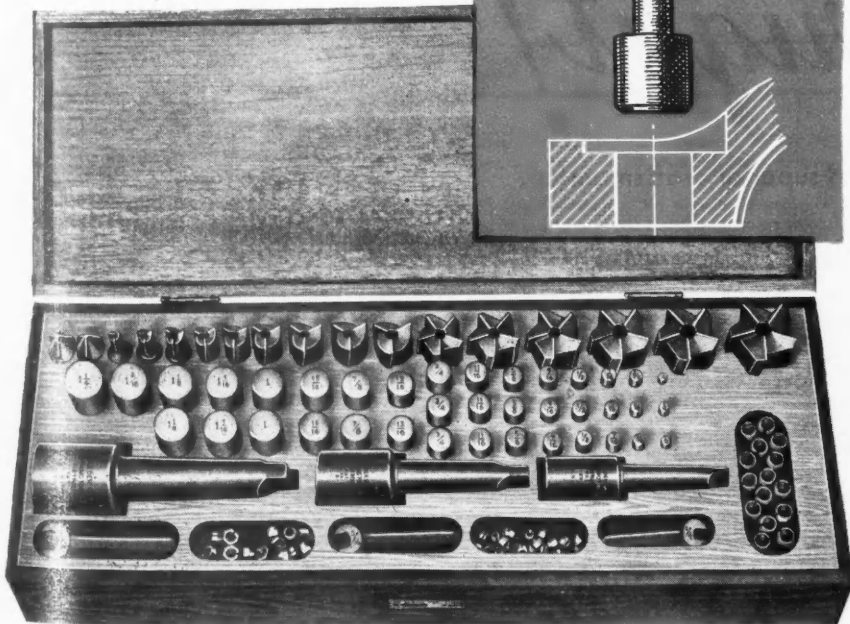
Today's production program demands accurate, efficient cutting tools within easy reach. Gairing standard kits (particularly recommended for tool rooms, machine, die and repair shops) provide the answer for all counterboring, countersinking and spot-facing operations.

There are seven sets from which to choose. Set B-4 is illustrated here. Each contains tools designed with special features to meet different requirements — each is a logical assortment of interchangeable counterbores, pilots and holders neatly boxed in sturdy wooden cases with stout hinged covers.

FIRST AID FOR THE TOOL ROOM

Write us today for our four-page Counterbore Bulletin illustrating, describing and pricing all seven sets.

**GAIRING
TOOLS**



Gairing Interchangeable Counterbore Set No. B-4

THE GAIRING TOOL COMPANY, Detroit, Michigan

Manufacturers of Standard, Special and Gair-Lock Inserted Blade Cutting Tools

The interchangeable holders in these sets are of Morse Taper or straight shank type. (Optional.) Threaded shank pilots are of selected alloy steel hardened and ground on the head. Shanks are drawn and treated to obtain unusual toughness and strength. High speed steel counterbores are renewable. The use of these interchangeable assemblies assures large savings over the old fashioned solid integral pilot type.

All counterbores, pilots and holders selected are standard items of the most active sizes used. Replacements may be quickly obtained from stock.

GAIRING
FOR OVER A
QUARTER CENTURY
SPECIALISTS
IN FINE
CUTTING TOOLS

Subcontractors Furnish Many Parts

(Continued from page 52)

tion if the Army Air Forces find it satisfactory. It is the I V 12-cylinder in line engine being built on an experimental basis by Continental Aviation & Engineering Corp. at its new Muskegon plant. Heretofore, the Allison has been the only U. S. liquid-cooled engine used in U. S. planes, although the British Rolls-Royce engine made by Packard is installed in the Curtiss P-40-F and in the North American P-51. Continental also is experiment-

ing with a supercharger on its new engine, which has been in the development stage since 1940.

Major production at the Continental Aviation & Engineering plant is on the Pratt & Whitney R-1,340 engine, a 9-cylinder, 650-hp. power plant used in the North American AT-6 and in airships. The first of these engines was produced April 16, a little more than nine months after excavation began for the plant. Construction on the wood, brick and concrete factory began July 8, 1942. The first machine tools were moved in last January and machining operations began Jan. 10. Shipment of spare parts started in March.

Continental Aviation & Engineering


is a subsidiary of Continental Motors Corp., which owns 50.9 per cent of the stock. Continental Motors has more than 18,000 employees in its five plants. The Detroit and Dallas divisions are making Wright Cyclone engines to power medium tanks, still the No. 1 U. S. tank engine, according to President C. J. Reese. The newly acquired Wisconsin Motor Corp. at Milwaukee, 72 per cent of whose stock is now owned by Continental, makes fractional hp. motors. The Muskegon Division has a diversified production of engines for aircraft, marine and industrial use, ranging from 69 to 700 cu. in. displacement.

Increasing demand for the Packard-built Rolls-Royce aircraft engine is indicated by another increase in its DPC commitment of \$16,500,000 for additional machinery and equipment and new test cells. This brings the total commitment to \$45,000,000.

A recent report by the Truman Committee revealed that 64,000 planes were built in the U. S. in the year ending June 30, 1943, an average output of 5,000 planes per month. From previous production data released, this indicates production of approximately 37,000 planes in the first six months of 1943 compared to 20,700 in the same period of 1942. Only 35 per cent of the year's aircraft goal was achieved in the first six months of 1943. The Navy reported that 9,000 planes had been added to its air force in the first half of '43. Aircraft production in May was up 5 per cent from April, according to the monthly report on munitions production by Donald M. Nelson. On the basis of airframe weight, May output advanced 10 per cent. Heavy bomber production moved ahead on schedule but Army fighter production lagged. Single engine bomber output gained 49 per cent in May while Navy fighter plane output was up 18 per cent.

However, total war production in May failed to register any gain over April volume. Output of ground ordnance was down 3 per cent in May while miscellaneous munitions dropped 7 per cent. Military automotive vehicle production advanced 3 per cent. May machine tool deliveries totaled \$113,710,000, a 4 per cent decline from April. Backlog as of May 31 was \$571,226,000, 10 per cent less than a month previously and 5.1 months' output at the May production rate.

Citing the production cooperation between the U. S. and Canada, Nelson recently reported at Toronto on the joint output of the two countries since the start of the war. This total includes 115,000 airplanes, more than 175,000 large caliber guns, nearly 1,500,000 machine guns, 6,000,000 rifles, 25,000,000 rounds of small arms ammunition, nearly 60,000 tanks, 1,600,000 trucks and 70,000 scout cars. Production of one Canadian vehicle, the T-16 Universal or Bren gun carrier, has been expanded to the Somerville plant of the Ford Motor Co.



To be right—Gages must have:

ACCURACY ★ FINE FINISH

★ LONG WEARING QUALITIES ★

★

Haines Gages
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Designed by an able and experienced engineering staff and made by skilled workmen in a plant thoroughly equipped with precision machinery and measuring devices, Haines Gages "are right" for the exacting accuracy requirements of aircraft engine manufacturers and other producers of war material.

Haines products include:

Standard A.G.D. Plug Gages—Steel or Chrome
Standard A.G.D. Ring Gages—Steel or Chrome
Special Gages—Flush Pin, Snap, Profile, etc.
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Let us quote upon your requirements for reliable delivery dates.



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"MORE PRODUCTION, BETTER FINISH, REJECTS ELIMINATED—Grinding Airplane Cylinder Valve Seats"



writes
**POR-OS-WAY'S
WAR PLANT
REPORTER**

Dear Charlie:

I'm writing this from the ~~plant~~ plant, and here's more bad news for the Axis. The use of Por-os-way is producing one additional airplane barrel, with valve seats precision-ground, every working hour. Multiply that one out, and you can see that Por-os-way's got something - something that the Axis doesn't like.

So long 'til next report
Your roving reporter
Vic

THE JOB:

Removing .010" to .012" from valve seats of airplane cylinder barrels on a Waddell Valve Seat Grinder—wet grinding at 5,000 R.P.M.

THE WHEEL:

Por-os-way 3¼" x ⅞" x 1⅛" C80 HV3.

All facts and figures given are taken from an actual field survey made by a Por-os-way correspondent.

WRITE for complete booklet "Facts About Por-os-way". The address is 466 Wheatland St., Phoenixville, Pennsylvania.

THE RECORD	POR-OS-WAY	FORMER WHEEL
Pcs. per Hour (2 Seats per Cylinder Barrel)	5*	4
Dressings	None	3 per wheel
Pcs. Per Wheel	300-375	120-150
Life of Wheel	1½ days	1 day
Average Depth of Cut	.005"—.008"	.001"—.003"
Rejects	None	2%
Finish	Superior	—

*Conservative. Por-os-way has proved ability to grind 8 pcs. per hour, or 100% more than former wheel.

Remarks (by foreman). "My men take pride in their work. If a wheel is too hard and burns work, it means lost time and material and gets them sore. We are sold on the merits of Por-os-way."

**2 TO 5 TIMES
MORE WAR PRODUCTION
PER MAN PER MACHINE**

POR-OS-WAY*
a new
RADIAC* PRODUCT



A. P. DE SANNO & SON, INC.
NEW YORK, CHICAGO, PITTSBURGH,
CLEVELAND, DETROIT, LOS ANGELES



PHOENIXVILLE, PENNA.
Western Gateway to
VALLEY FORGE

*T. M. Reg. U. S. Pat. Off.
COPYRIGHT, 1943, A. P. de Sanno & Son, Inc.

*Finer Appearance—
Better Performance*

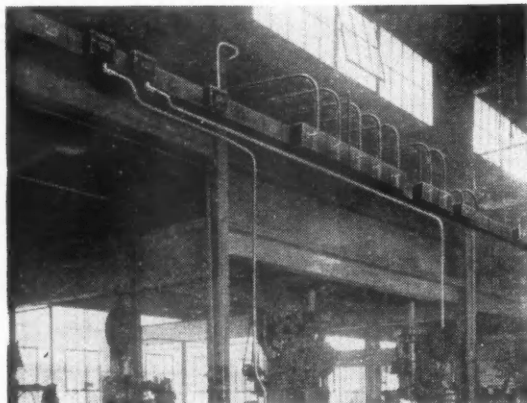


**Yet It Saves Much Steel
and Copper In Conformity
with WPB Limitation Order L-273**

On Feeder runs, Bulldog's Ventilated Type LO-X Duct puts more power through to branch circuits with less voltage drop. The screened casing not only improves appearance but prevents excessive heat—cuts weight—conserves a maximum of critical materials.

At the same time, Ventilated LO-X shares all the basic advantages of Bulldog BUStrribution Duct design. It is quickly and easily installed—has full asset value—is 100% salvable.

LO-X Ventilated Bus Duct for Main Feeders is available in the new WPB ratings of 800A, 1000A, 1350A, 1600A and 2000A. Single-phase, 3-phase, and 3-phase 4-wire; 600 Volts or less.



Flexible Light and Power

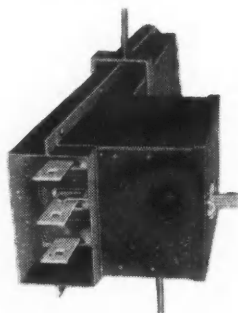
(Above) This shows a Branch Circuit run of BUStrribution DUCT with circuit protective devices plugged in at points most convenient to the machines they energize and protect. Each 10-ft. section of plug-in duct has 10 outlets for the insertion of these plugs, which can be readily moved with the machines and instantly plugged in at any other desired location. It is 100% flexible and salvable.

Capacities available under new WPB standards are 250A, 400A and 600A for branch runs of Plug-in Bus Duct.

MANUFACTURERS OF a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Circuit Breakers and BUStrribution SYSTEMS.

You SAVE when you SPEND on WAR BONDS

**Plug-in Type
for Branch Circuits**



(Right) End view of a branch circuit plug mounted on a bus duct section. Note how the copper "contact fingers" of the plug, inserted through a plug-in opening in the duct casing, clamp over the busbars in the duct.

Wiring between plugs and machines is made in short runs of rigid or flexible conduit.

Plugs may be of the fusible switch type or automatic circuit breaker type and are readily interchangeable. Capacities: 30A to 600A; 600 Volts or less.

BULLDOG
ELECTRIC PRODUCTS CO.

Detroit, Michigan

Bulldog Electric Products of
Canada, Ltd., Toronto, Ontario

Field Engineering Offices
in All Principal Cities

**Steel Allotments for
Civilian Requirements**

(Continued from page 50)

minder that the steel industry has permitted no grass to grow under its feet in adapting itself to the aviation industry's special requirements.

Maximum prices have been established by OPA on primary grade aluminum ingot, a new grade of ingot made by blending from 50 to 70 per cent of scrap with primary metal. The ceiling prices range from 15 to 15½ cents a pound. "The Statement of Considerations," which accompanied the OPA announcement, said in part: "In order to insure the orderly movement of aluminum ingot derived from scrap and to augment the alloying facilities of producers, the War Production Board has decided to allocate primary aluminum pig of high purity, 99.75 per cent or better, to the secondary smelters for the purpose of blending with scrap for the production of the critical casting alloys: Numbers 142, 195, and 355. With high purity pig it is possible for the smelters to blend from 50 to 70 per cent of scrap with the primary pig and produce a primary grade ingot comparable in every respect with the aluminum ingot sold by the primary producers and meeting rigid specifications." Initial power units for the generation of the needed electricity in the manufacture of aluminum, first step in organizing its aviation industry, are reported being under construction in Brazil under government auspices.

Chile, second only in copper production to the United States, is stepping up her production of the metal. A plant for processing ores that formerly had to be shipped abroad for conversion and that will have 30,000 tons capacity annually is being hurried to completion, scheduled for the end of the year. The U. S. Government's Metals Reserve Company is lending every possible assistance.

P.A.E.A. Elects Officers

At the annual meeting of the Pneumatic Automotive Equipment Association held at the Edgewater Beach Hotel, Chicago, the following officers were elected: President, B. J. Scholl, Brunner Manufacturing Co.; vice-president, J. M. Wells, Ingersoll-Rand Co.; secretary-treasurer, H. O. Holland, Kellogg Division of American Brake Shoe & Foundry Co.

At the meeting, the Limitation and Conservation Orders under which the industry is now operating were discussed and considerable time was devoted to the simplification program and to the matter of a commercial standard for the industry. The latter project is being developed in cooperation with the United States Department of Commerce, National Bureau of Standards, Washington, D. C.



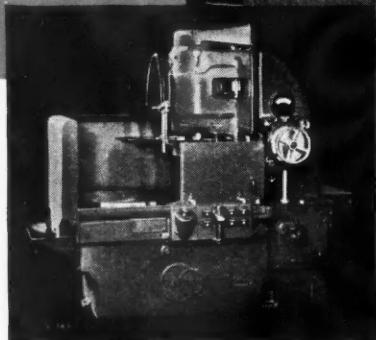
**CHECK THESE
ADVANTAGES
OF BLANCHARD
GRINDING**

- ★ **Production**
- Adaptability**
- Fixture Saving**
- Operation Saving**
- ★ **Material Saving**
- Fine Finish**
- Flatness**
- Close Limits**



..... Especially
valuable on jobs like
the one illustrated.

"PUT IT ON THE BLANCHARD"



*Grinding floating flanges for
connecting and parallel rods
on Blanchard No. 18 Surface
Grinder*

THE Blanchard No. 18 Surface Grinder, shown above, is used for odd lot jobs in one of this country's leading railway shops. Other jobs up to 36" in diameter are also ground on this machine.

The job shown is boiler steel floating flanges for connecting and parallel rods. $1/32$ " of stock is removed from both sides to limits of .002" for flatness. 37 pieces (72 surfaces) are produced per hour.

These odd lots are ground at a profit on the Blanchard No. 18 because the set-ups may be changed quickly—the required limits and finish are easily maintained and held—and maximum production is obtained.

The **BLANCHARD**
MACHINE COMPANY
64 STATE STREET, CAMBRIDGE, MASS.

Send for your free copy of "Work Done on the Blanchard." This book shows over 100 actual jobs where the Blanchard Principle is earning profits for Blanchard owners.



Ford Glider Plant

(Continued from page 46)

nage. The smallest finger hooks into the Fairing Department. The thumb is the final assembly. Everything to become part of a glider eventually makes its way to the doping room. Small metal parts are placed on trays and sprayed with paint. Wings are rolled in and covered with fabric and dope. Fuselage sections are moved forward to undergo the same process. Before fuselage sections are clad in fabric, all sharp corners are covered with cellulose tape. Parts of the tubing,

especially that forming the bottomside of the windshield, also are wrapped in tape. Scalloped to obviate unraveling, the tape serves as a base to which fabric is anchored when it is wrapped around tubing. Tubing and fairing also are doped in early stages of assembly, doping room, rust-resistant green paint being sprayed on the tubing. Two coats of dope are applied to fairing. On arrival at the doping room, the nose of fuselage is doped along plywood skin covering lower part of front, with two coats being applied. Fabric is then fitted on and held in place, temporarily by tacks.

Stretched over the framework, the

fabric is sewn and glued, after which a stiffening preparation is applied two or three times by brush. Then the nose is moved into spray booth where other protective coats are sprayed on. After these have dried, the nose is returned to the booth and camouflage paint added to the other weather-resisting, stiffening layers. Bottomside of glider is painted neutral gray; upper an olive drab. A similar doping process is applied to the center section. Then after the second coat is added, the fabric is cut away for openings for a doorway set under each wing, for triangular-shaped emergency doors, and for eight portholes, four on each side. A large opening also is cut out of upper part of center section for the fitting in of the inner wing. An aluminum strip is installed to seal the junction.

Following the trimming of the fabric other openings are made. A small rectangular hole just above the floor is cut out for the cable used to release combat landing gear when plane is aloft. Another opening is cut around a bracket just above the rear unit of landing skids. Other openings are knifed out for wing strut brackets. All of these are reinforced with cellulose rings and fabric collars.

Two hand holes are cut out on each side of glider, just above the underside. Zippered L-shaped openings, two on each side, also are made to increase accessibility in servicing empennage parts. Six openings are cut in tail section and 34 on floor of center section to allow for water drainage. Other openings are made for small stabilizer brackets.

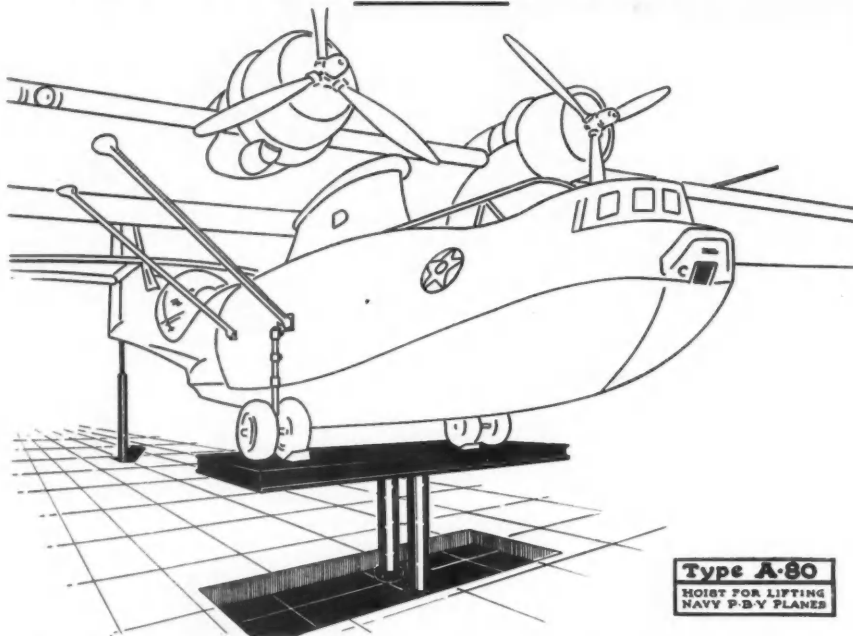
Openings also are knifed out for 12 air vents, six on each inside. These are capped by plastic nipples, in each of which is an underside slot permitting the passage of air. Emergency and other doors are treated and installed. Inboard and outboard wings, dorsal fins, ailerons, rudders and other sections turned out in Building No. 3 also pass through the doping room to be doped and covered with fabric. Once they are given a final coat of camouflage paint, they are monorailed to the final assembly.

Final Assembly

On the final assembly line, which was laid out to accommodate seven gliders, workmen join the three main fuselage sections together, attach the wings, V-struts and empennage. Wheels and landing gear also are installed, as are panel board and radio. Immediately following complete assembling of each glider, it is inspected by Ford and government experts. Once a glider is approved, it is then dismantled, the assemblies crated and shipped in 20 sections—three fuselage sections; four wing sections; two V-struts; two ailerons; seven empennage sections; and two landing gears, one for training flights, the other for combat use. It is equipped with the latter type, which is dropped after the glider soars aloft headed for combat.

GLOBE "ROLL ON" HOIST LIFTS PBY-TYPE PLANES

Oil-Hydraulic Platform Facilitates Repairs, "Flight-Positions" Plane for Instrument Checking



Designed to lift Navy PBY Amphibian planes, the A-80 Globe Airplane Hoist provides a quick, easy way to "flight position" these planes, as they leave the production line, for adjustment and calibration of instruments, armor and controls. Also speeds and facilitates routine inspection and repairs to the hull; or can be used to lower hull into a cradle to provide "free wheeling" of landing gear for servicing tires, etc. Hoist consists of

a 3' x 15' platform mounted on dual hydraulic pistons having a maximum lift of 6' and a single telescoping piston with a maximum lift of 14' mounted so as to contact the plane's towing ring. When lowered, both units leave the floor area entirely unobstructed. For data on all types of Globe Airplane Hoists, write Globe Hoist Co., Mermaid La. at Queen St., Philadelphia, Pa.

GLOBE HOIST COMPANY
Makers of the famous GLOBE Auto HOIST
Philadelphia, Pa. Des Moines, Iowa

GLOBE
HYDRAULIC AIRPLANE HOISTS



History relates that when Faraday demonstrated electricity to Gladstone, the great statesman remarked, "But what earthly good is that?" . . . When Bell's invention of the telephone was reported to U. S. Grant, the general observed, "But what could it ever be good for?"

GLADSTONE and Grant once went into business together. Combining the happy qualities of diplomacy and aggression, they soon did a right brisk business in such staples as ear trumpets, harness and sundries.

They had two bright young fellows working for them named **Mike Faraday** and **Alex Bell**, and if ever a company should have gone to town, it was G. G. & Co. For it seems that Mike had been tinkering with harness for a new kind of horsepower, while Alex had invented a new kind of hearing aid . . . but they couldn't interest the management in the future of these things.

So Mike and Alex left and went into business for themselves, and they've been doing nicely ever since. While Gladstone, Grant & Co. stayed in harness and tin hearing aids, and folded like a tent in a heavy wind.

★ ★ ★ ★ ★

There's a point to this little fable: Today there are many promising businesses — in the hands of capable management — that are also going to fold like tents when the post-war trade winds blow.

The success of many businesses after this war will depend upon the planning that is being done now. On any problems involving the use of precision machine tools, we urge you to call upon our engineers — as many of America's leading companies have been doing for more than a century. Call upon them now!

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Threading Dies

JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.
Profit-producing Machine Tools

AC Automatic Pilot Production

(Continued from page 37)

Finished gyro assemblies are given a final inspection in the laboratory, using specially-designed analyzers for the purpose. The first test is made by AC inspectors, followed by a second check by Air Corps inspectors.

Owing to the multiplicity of parts that make up the automatic pilot, our survey of machine shop facilities needs must be of generalized nature. For one thing, the operations have been carefully departmentalized in the interest

of economy. Consequently, some parts in the machine shops are run on a job-lot basis, as contrasted with the straight-line assembly operations.

First major plant department is the die-casting division. AC has been noted as a die-casting specialist and this project has given broad play to the talents of the organization. The automatic pilot requires some 300 aluminum die-castings, varying from small levers to large housings. The familiar

Do-All sawing machines are used for cleaning operations, removing flash, etc.

The grinding department handles all grinding operations on shafts and gears, includes batteries of Landis hydraulic grinders, Norton cylindrical grinders, Thompson surface grinders, J & L precision thread grinders.

Then there is a large drill press department outfitted almost entirely with batteries of six-spindle Foote-Burt drills and Allen sensitive drills.

An extensive milling machine department handles the variety of milling operations on castings and machined parts. Here will be found a large battery of Gorton vertical spindle millers, used largely for end-milling; Pratt & Whitney profile millers of ordnance type; Cincinnati milling machines; Hardinge millers; etc.

Another bay houses the lathe department. Prominent here are: a long row of small Elgin bench lathes; a battery of Monarch lathes, using Carboloy tools on non-ferrous parts; Heald Bore-Matic precision boring machines, using Carboloy tools; and Warner & Swasey turret lathes. An interesting piece of equipment in this department is a special machine, developed by GMR for cutting a long variable pitch screw on a shaft. Cutting is done with a tiny end mill of special form.

In contrast to the general machine shop departments mentioned above, there are several specialized departments for large die-cast parts. One such line is set up for machining the gimbal, bail, and vertical ring. Line boring operations on these large parts is done in Ex-Cell-O precision boring machines.

Another such set-up is the large frame casting department. Principal operations here are drilling and tapping on multiple-spindle Natco drills; and milling operations on Pratt & Whitney ordnance type profilers.

All of the aluminum die castings are anodized in the plating department, using a large automatic Udylyte system anodizing machine.

Perhaps the largest of the manufacturing departments is the gear department which is housed in a separate building. This produces a variety of some 250 gears and screw machine parts used in the automatic pilot assembly. An extensive screw machine section is a feature of this plant. Major items of equipment are the Brown & Sharpe automatics—types OG and 2G—Swiss automatics W & S turret lathes; and a battery of Bardons & Oliver turret lathes for large parts. Carboloy-tipped tools are used extensively in this department. It is of interest to find that the Brown & Sharpe automatics are specially tooled to bore and ream holes in tiny gear blanks to tolerances of 0.0005 to 0.0006 in., a performance considered to be quite exceptional. Cincinnati centerless grinders also are found here, for the finish-

(Turn to page 70, please)

The Answer— TO YOUR BEADING PROBLEMS!

A WAYNE Tube Beader beads tubes many times faster than former methods, assures uniform, perfect beads . . . and is so nearly automatic in operation the most inexperienced man or woman can operate it. Users report 3,000 to 5,000 beads per eight hour day per machine. Write for list of users and bulletin today.

THE WAYNE PUMP COMPANY
FORT WAYNE 4, INDIANA

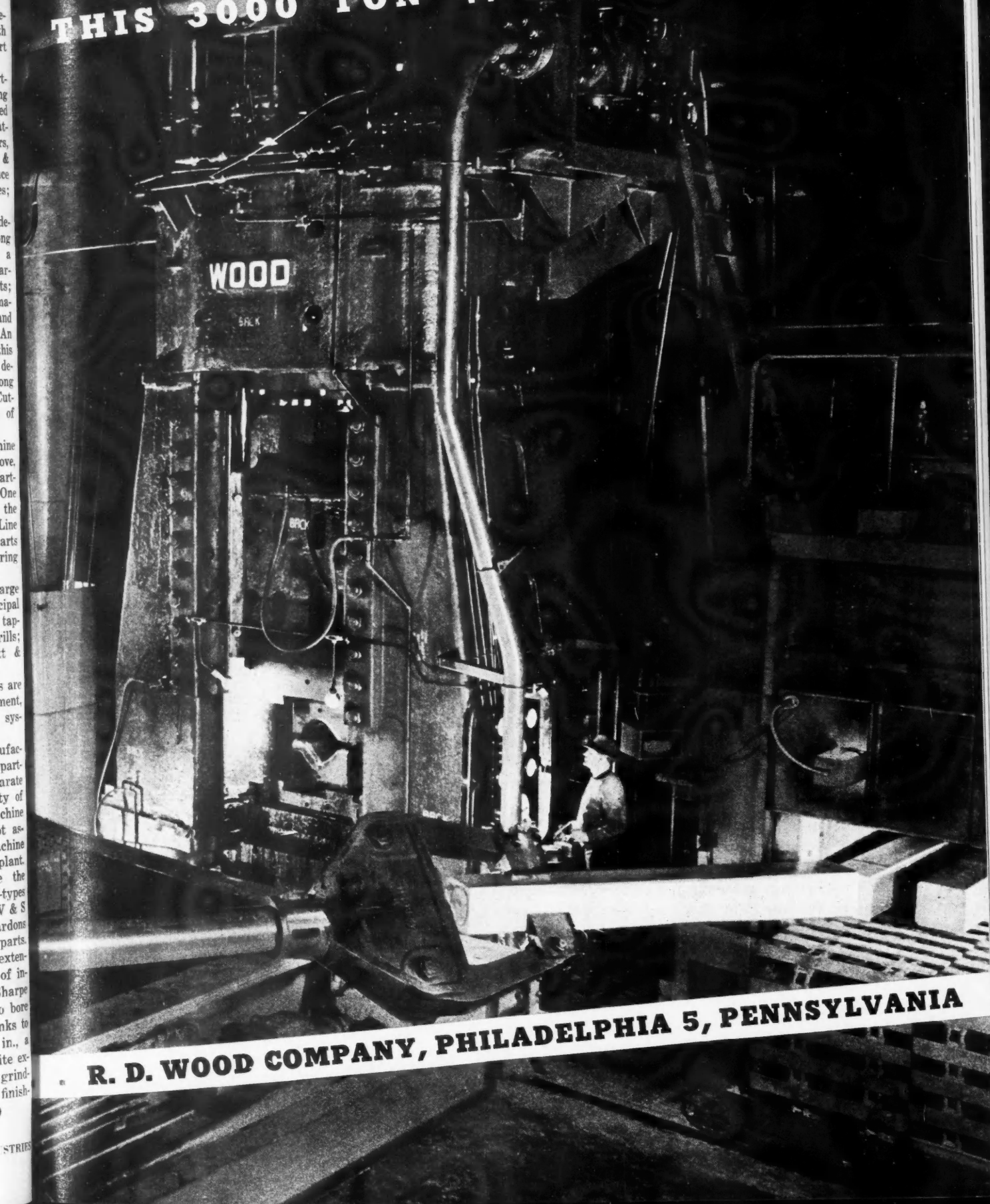


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WAR BONDS



TUBE BEADERS

OF ALUMINUM WITH
THIS 3000 TON WOOD PRESS!



R. D. WOOD COMPANY, PHILADELPHIA 5, PENNSYLVANIA

AC Automatic Pilot

(Continued from page 66)

grinding of small shafts of every description.

The automatic pilot contains miniature transmission trains with tiny automotive-type clutches. The gears comprise—spur teeth of internal and external type, helical gears, spiral sections of shafts, and bevels, in a wide range of pitch and diameter.

They range from the smallest gear— $\frac{1}{4}$ -in. pitch and 64 DP—to 38 DP gears several inches in diameter. Gear

blanks are made of aluminum, bronze, and stainless steel.

The familiar Gleason gear generators, of small sizes, are employed for cutting bevel gears. Fellows gear shapers are used for cutting internal and external gears and sectors. One of the larger internal gears cut on the Fellows shaper has 128 teeth. These blanks are narrow and are cut three at a time. A battery of Barber-Colman Type S gear hobbors—ordinarily used for fine watch-making—are employed for the cutting of tiny gears. Another group of larger Barber-Colman hobbors is used for cutting spiral sec-

tions on shafts and for spur and helical gears.

Two different methods are used for finishing gears. In one, the spur and helical gears are finish-hobbed on Barber-Colman hobbors, using ground hobs, then burnished in Fellows burnishing machines; in the other—a more recent development—the gears are rough-cut on Barber-Colman hobbors, then shaved on Red Ring gear shavers.

Gear operations in this plant are extremely fussy due to the unusual character of tolerances. They have to be right from the start if the precision assembly requirements are to be met. Frequently the bore is held to extremely fine tolerance while the pitch diameter is held to close concentricity. In one instance, the bore of the gear is held to a tolerance of 0.0006 in., while the pitch diameter is specified to run 0.001 in. concentricity with full indicator reading. To accomplish this in a mass-production setup, the operator of the Barber-Colman hobber is provided with an assortment of bushings which permit of a selective fit in any given gear blank. This arrangement provides a uniform bore for the arbor, assures concentricity regardless of extremely minute variations in the bore of the gear.

Another unusually severe hobbing job is that of a long shaft on which is cut a spur gear running about four inches along the shaft axis. These teeth have to be maintained accurately as to P.D., tooth form, and concentricity.

Burring of tiny gears posed a serious problem since the conventional method of hand burring was out of the question in a mass-production program. A unique solution was found by AC engineers in cooperation with the gear plant management. They designed a small gear box with a multiplicity of shaft mountings so that stocks of small gears could be mounted on the shafts for burring. During the running-in operation, the gears are bedded in fine emery dust which does an effective job of burring and polishing of the tooth surfaces. The machine is controlled electrically to operate on any selected cycle of operation—rotation in one direction for a pre-determined length of time, then a reversal of rotation, etc.

A similar machine is used for burring larger gear sectors. The secret of the success of this operation is found in the determination of the proper operating cycle, coupled with the use of emery dust of different fineness, selected for each type of gear.

Even though the automatic pilot project is under full production activity, AC engineers are constantly on the lookout for improvements and short-cuts so essential to the best utilization of man-power and facilities. In this program a great deal of attention has been devoted to the design of jigs and fixtures of such character as to simplify the operation and safeguard quality. The same consideration has been given to the fixtures used in the assembly department for sub-assembly and final assembly operations.



CAST ALUMINUM FITTINGS

YES! NIBCO fittings of cast aluminum . . . accurately machined to absolute uniformity . . . are moving at ever increasing speed into the aircraft plants where they're needed . . . delivered on time . . . meeting the most rigid standards and the stiffest inspection. The same engineering genius which developed the NIBCO Wrot Fitting formed in one step from a straight tube of copper, is meeting in outstanding fashion, the new problems which the war has created. Our facilities are 100% devoted to War work now . . . but when the new day comes . . . you'll need us and we'll need you.



NORTHERN INDIANA BRASS CO.

ELKHART, INDIANA

VALVES AND FITTINGS SINCE 1904





A Letter from Guadalcanal...

In a recent letter from a lad at Guadalcanal to his former employer was voiced the greatest challenge of our time.

"What," he said, "am I, and all these fellows with me, going to do when this thing is over?" Is peace to bring with it the deadly spiral: men laid off and demobilized, hence less purchasing power, hence more plants closed down, hence more men laid off, hence — ?

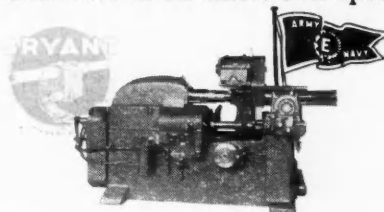
We believe we've seen the answer right on the production lines and right in the post-war plans of American industry.

We've seen and consulted with hundreds of research men uncovering new secrets in metallurgy, synthetics, plastics, aeronautics — finding

new techniques and economies — planning new and wonderful products that will cushion the post-war interim to the greatest production age in history.

As internal grinding specialists, we at Bryant have already helped to solve production problems involving the machining of many new light metals, alloys, and synthetic materials including glass, plastics, hard rubber, wood, graphite, and even machine parts made of paper.

We've developed many new techniques in tooling, and we believe that this knowledge is important to your future. For that reason, our Consulting Service is available at all times. Call upon us now!



Bryant Chucking Grinder Company

Springfield, Vermont, U. S. A.

August 1, 1943

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- increase pride in work
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Famous companies throughout all industry now are using these plastic sealed armbands. They are finding they help produce more—better—faster. This is because they identify key employees by proper title, eliminate confusion, and increase the worker's pride in his position just as insignia of rank contribute to morale in our fighting forces.

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either with your company name imprinted or in stock designs, they can be made up for you in your choice of a wide variety of sizes and styles. Department names or employee titles can be shown.

MANY OTHER PLASTIC ITEMS—

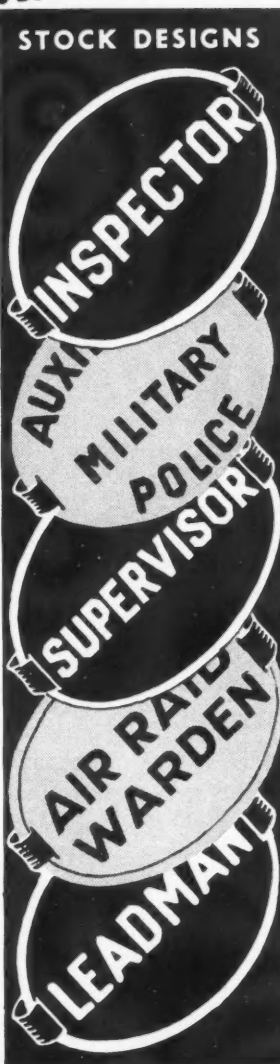
can be supplied promptly. Tool checks, identification badges, job ticket holders, with or without company identification are included. All are of highest quality, scientifically designed to meet your needs.

You'll find they save their cost many, many times over.



NO DELAY

**ALL ORDERS
FILLED
PROMPTLY**



PLASTIC DIVISION
HOLLYWOOD ATHLETIC CO., 211 E. 7th St., Los Angeles, Calif.

Please send me at once, samples and prices on items checked below:

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Address _____ State _____

(Signed) _____ Title _____

New Products for Aircraft

(Continued from page 45)

Automatic Engine Speed Synchronizer

The Curtiss Automatic Engine Speed Synchronizer was developed by Curtiss-Wright Propeller Division of Curtiss-Wright Corporation, New York, N. Y., after extensive laboratory and test-stand work following a program initiated several years ago under the sponsorship of the U. S. Army Air Forces and the U. S. Navy's Bureau of Aeronautics. The device enables pilots and flight engineers of multi-engined combat and cargo planes, by adjusting



*Curtiss Automatic Engine
Speed Synchronizer*

a single control knob, to obtain the desired engine speed for maximum efficiency and at the same time automatically synchronize all of the engines at this speed. The conventional propeller control system requires that the pilot manipulate four separate levers, one by one, in order to synchronize the engines.

Flexible Compound Made from Ameripol

Development of a compound made from Ameripol, the synthetic rubber created in its laboratories, which will remain so flexible at—70 degrees Fahrenheit that it can be bent at an angle of 90 degrees around a half-inch rod, is announced by The B. F. Goodrich Company, Akron, Ohio.

The new compound is being used in the construction of bolted tanks for storage of the high octane gas and aromatic fuels used in aircraft.

Cherry Rivet Gun Kit

Cherry Rivet Company, Los Angeles, Cal., is making a rivet gun kit to aid field service and repair men in heading up Cherry Blind Rivets. The G-10 hand gun is included in the kit which



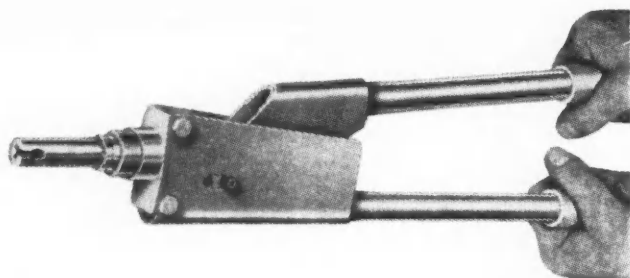
Spicer Transmissions, Universal Joints and Propeller Shafts— proved by famous A.C.F.—and in the front line A.E.F.

In the gruelling duty of constant stop-and-go public transportation, Spicer Transmissions, Universal Joints and Propeller Shafts have helped A.C.F. Buses establish a great record for quick, safe, on-time service . . . Now these same Spicer Units are helping land Allied armies, equipment and supplies quickly, safely, and on time in our scheduled march to Victory. Spicer was ready when war came—Spicer again will be ready when peace is declared. Spicer Manufacturing Corporation, Toledo, Ohio.



BROWN-LIPE CLUTCHES AND TRANSMISSIONS • SALISBURY FRONT AND REAR AXLES

SPICER UNIVERSAL JOINTS PARISH FRAMES, STAMPINGS



**G-10 Hand Gun
for Cherry Rivets**

permits servicing operations where air power is not available.

The principal feature of the kit is its complete complement of pulling heads and other accessories for the

G-10 hand gun, making it practical to do a first class riveting job in the shortest possible time. Hand gun operations are not necessarily confined to emergency repair jobs in the field but

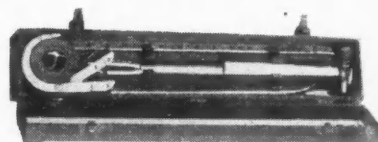
are proving helpful in factories and modification centers where the time involved in connecting compressed air equipment for certain jobs is not warranted.

The kit also contains a right angle adapter used in inaccessible places that cannot be reached through a straight pull in line with the axis of gun head.

Six interchangeable pulling heads are also included for sizes: $\frac{1}{8}$, $\frac{5}{32}$ and $\frac{3}{16}$ in. standard diameter rivets, one each for countersunk and brazier type heads in all sizes.

Firestone Kit for Airplane Tires

The Firestone Tire & Rubber Company, Akron, Ohio, has just brought out a tool for loosening airplane tire beads from the rims. Compact and conveniently packed, the tool is said to be as well suited to a front line emergency field as to a regular airport. The new



Airplane Tire Kit Built by Firestone

bead loosening tool makes it possible to remove tires without damaging them, and at the same time speeds up airplane tire service work. The tool already has been tested by the Army Air Forces with excellent results. Firestone provides the bead loosener in a kit 38 in. x 6 in. x $6\frac{1}{2}$ in.

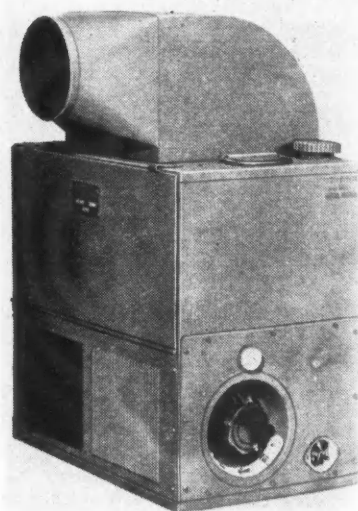


Tanks, tractors, half-tracks, supply trucks and jeeps—the "BENDIX" Drive starts 'em all!

On Arctic, desert, and jungle fronts, the "BENDIX" Drive is in at the start of every action. It's the same great, dependable starting unit that hung up a record for quick, sure starts in more than 60,000,000 engines. A record established both as original equipment and replacement units.



The "BENDIX" Drive is a vital member of "The Invisible Crew"—precision equipment which 25 Bendix plants from coast to coast are speeding to world battle fronts.



Hunter U-H-2 gasoline heating and ventilating unit, made by Hunter and Company, Cleveland, Ohio, is rated at 12,000 to 25,000 B.t.u. per hour and 200 c.f.m. circulation, weighs 47 pounds and occupies less than two cubic feet of space. Heat-directing hood fits four ways and may be connected to ducts. This heater suggests a wide range of application to heating and ventilating trucks, trailers, tents, shelters or portable buildings.

ECLIPSE MACHINE DIVISION

SAVE HOURS OF TRAINING for your Screw Driving Army

YESTERDAY . . . TODAY



PHILLIPS SCREWS ARE FOOL-PROOF!

Light-fingered and feminine . . . heavy-handed and he-man . . . raw recruit or veteran. All can be put on a high-production level on your assembly line by giving them Phillips Recessed Head Screws.

The scientifically designed Phillips Recess automatically centers the driving force and eliminates all driving troubles . . . fumbling, wobbly starts . . . slant-driven screws . . . burred and broken screw

heads . . . and dangerous screw driver skids.

Screw and driver "become one unit", making such efficient use of turning power that driving is much easier and faster, regardless of driving method. And, power driving is made practical in most cases.

They cost less to use! Compare the cost of driving Phillips and slotted head screws. You'll find that the price of screws is a minor item in your total fastening expense . . . that it actually costs less to have the advantages of the Phillips Recess!

KEY TO FASTENING SPEED AND SAFETY

The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting - Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving - Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving - Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings - Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.



PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOL

21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.

International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Perker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.

Phell Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

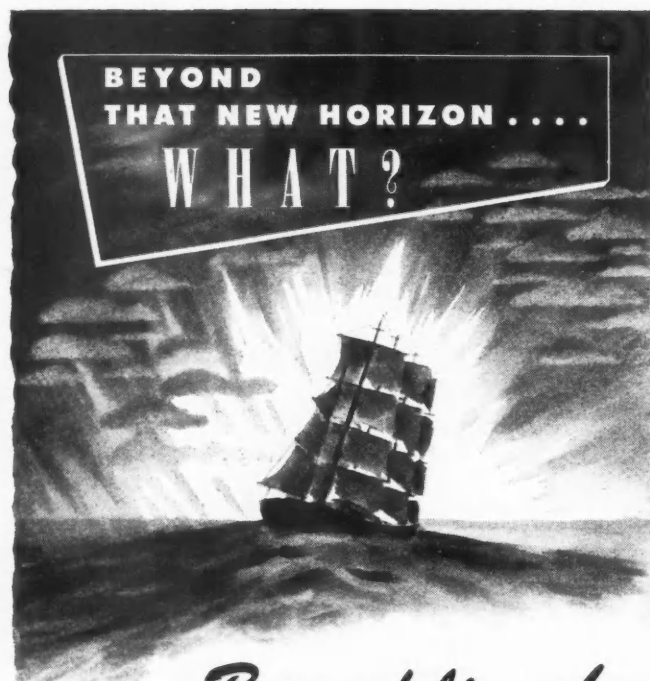
New Production Equipment

(Continued from page 43)

The grinding wheel can be set at a desired angle to move in any direction by means of the unusual arrangement of cross and circular slides and other adjustments which give the effect of a double universal joint. This permits the forming of any shape no matter how intricate, and also makes possible the grinding of rake and clearance angles simultaneously with grinding the form. The work is viewed in the operating plane and the profile is ground directly from the layout.

The layout size is 20 in. square,

which makes possible grinding an area 0.400 in. by 0.400 in. in one setting. Profiles greater than 0.400 in. in area can be handled by other methods with the same equipment. Work may be accommodated up to 10 in. wide and 4 in. thick. Stock can be stacked to a height not to exceed 2 in. to produce several identical parts at one operation. The machine can also be used reversely for making 50 to 1 layout drawings from parts with unknown profiles and for checking parts against layout drawings.



Beyond lies change

BEYOND lies an uncharted sea of post-war problems: the redesign and re-application of war-born techniques, processes and products to peacetime demands.

To help guide those changes, to make sure that they shall be "changes for the better"—that is Aetna's job.

Though intensely preoccupied with war production, like all American industry, Aetna has found time to study, test, develop . . . to perfect new methods, new

devices, new and faster ways to produce better bearings with greater friction-conquering characteristics.

With you, Aetna looks forward to the era of peace; to products made not for destruction and death but for happier, more comfortable living; to an opportunity to assist you in solving bearing problems that lie beyond the horizon.



Aetna Ball Bearing Manufacturing Company, 4600 Schubert Ave., Chicago, Illinois.

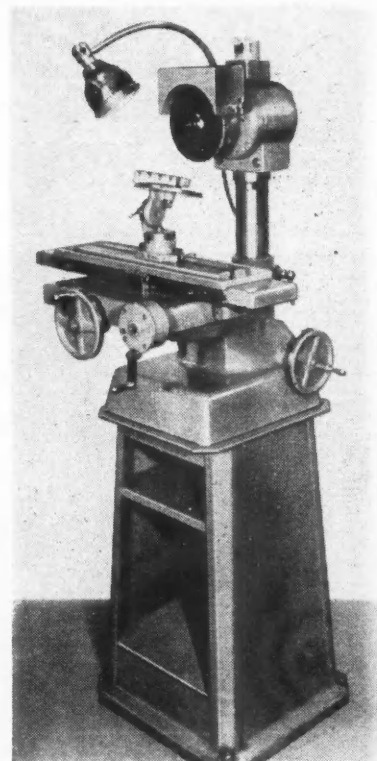
In Detroit: SAM T. KELLER, 7310 Woodward Avenue, Phone Madison 8840-1-2.

Aetna

THRUST (STANDARD AND SPECIAL)
ROLLER BEARINGS (SPECIAL)

BALL BEARINGS

AND ANGULAR CONTACT BALL BEARINGS
HARDENED AND GROUND WASHERS



Carboloy Chip Breaker Grinder

A NEW carbide tool chip breaker grinder with greater flexibility and higher capacity has been announced by Carboloy Company, Inc., Detroit, Mich. Replacing the former model, the new grinder is designed for grinding of chip breakers in single point tools and roller turner tools. It can also be adapted to use for grinding flat form tools and round or square boring bits.

Table length of the new grinder, which can handle tools up to 2 in. wide, has been materially increased while construction is even sturdier than the previous model. The long table with 10 3/4 in. of travel makes possible the grinding of breakers in both right and left hand tools without moving the universal fixture on the table. Designed for the use of 6 in. wheels, the head is vertically adjustable from either side of the machine.

A base, 29 in. high with large storage space for tools, wheels, etc., is available with the new grinder. Standard motor is single phase 110 volt 60 cycle, 1/4 hp at 3450 rpm.

A universal fixture and vise for holding tools up to 1 1/4 in. wide is provided with the machine, while a vise designed for holding tools up to 2 in. wide is available at nominal additional cost.

A NEW line of direct-current vertical motors ranging from 40 to 200 hp. at 1750 rpm., and in equivalent ratings at other speeds, has been placed on the market by the General Electric Company, Schenectady, N. Y. The new motors, which are furnished for both constant and adjustable speeds, are

(Turn to page 80, please)

Teamwork IS Essential

**WE MAKE THE HYPROLAPS
YOU MAKE THE PISTON RINGS**



Norton HYPROLAPS
the plant of America
Hammered Piston Ring
Division, Baltimore, Md.

Yes, batteries of Norton Hyprolaps are producing piston rings for the aircraft and the land transport of the armed forces. Norton Lapping Engineers are giving these plants expert assistance.

It's the kind of teamwork needed in this war effort.

And Norton Company pledges to continue that kind of service. Whether Norton Grinding and Lapping machines in *YOUR* plant number into the hundreds or whether you have but a single machine tucked away in a shop corner, Norton Service is available.

NORTON COMPANY, WORCESTER, MASS.

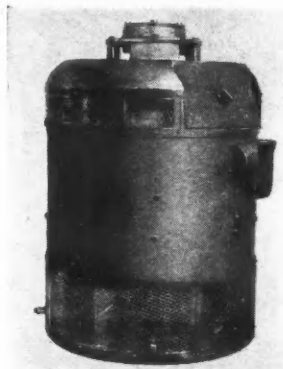
GRINDERS
Lappers

New Production Equipment

(Continued from page 76)

designed for low-thrust, solid-shaft applications on pumps, machine tools, and marine underdeck auxiliaries. They are also desirable in cases where valuable floor space must be saved or the expense of gearing avoided.

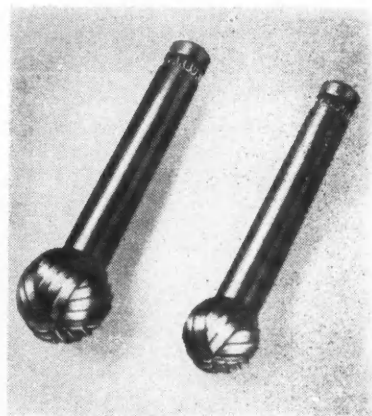
The motors are of dripproof, protected construction, providing complete protection from dripping liquids and falling objects. Fittings on both the upper and lower bearings simplify lubrication, and provision for the escape of excessive grease reduces the possibility of over-lubrication. A special bearing housing prevents grease



New General Electric Vertical Motor

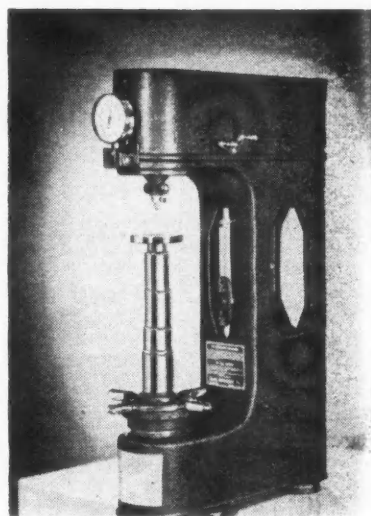
from entering the motor and damaging the commutator and the windings.

The cast-iron conduit box can be arranged for bringing the leads in at the top, bottom, or either side. Two hand-hole covers, removable without the use of tools, permit inspection of the commutator end brushes. The ring-type base has an accurately machined rabbet, and jig-drilled mounting holes, thus assuring permanent alignment with the driven machine. Lifting lugs facilitate installation.



These tools, known as Carburs, are now in production at Carbur, Incorporated, Lincoln Park, Mich. They are said to be the first cemented-carbide burring tools ever to be produced. The cutting teeth are ground from the solid, and the cemented-carbide heads are securely attached to the shanks. Carburs are supplied in ball end types in $\frac{3}{8}$ in. and $\frac{1}{2}$ in. sizes. The shanks are .250 in. diameter, and the over-all length of the tools is $2\frac{1}{2}$ in.

CLARK Instrument, Inc., Dearborn, Mich., is offering an improved hardness tester for "Rockwell testing" in three models, US8, US12 and US16. Among its features are a frictionless spindle which provides a correct minor load at all times; zero drag trip which



Clark Hardness Tester

eliminates friction or drag on the loading beam insuring accuracy of the major load, a dial indicator adjustment

THOSE HIDDEN COSTS...NOW ARE PROFITS!

The correct
oil film
to each
individual
bearing...

automatically

BIJUR

AUTOMATICALLY *Correct* LUBRICATION

- Remember them? Oiling time lost from productive work . . . Lubricant wasted . . . Production delays . . . Increased depreciation.
- How those hidden costs gnawed at profits! Money that now is clear . . . simply by the convenient, economical use of BIJUR lubricated machines. Clean lubricant is pumped and fed automatically . . . to each bearing the correct oil film it individually requires. No lubrication troubles . . . even to think about!

BIJUR LUBRICATING CORPORATION

LONG ISLAND CITY, NEW YORK

BLISS
Power
Press

707

affording means of maintaining accuracy of readings, and a minor load adjustment.

Other features of the instrument are fully enclosed elevating screw with self-lubricating oil reservoir, and an adjustable steady rest. The instrument is supplied complete with diamond cone penetrator and steel ball penetrators for "Rockwell testing" on "C" scale, "B" scale and most other standard Rockwell scales.

GRAYSON-KENAMETAL milling cutters, constructed with bodies of Meehanite tipped with Kennametal, are a recent development of the McKenna Metals Company, Latrobe, Pa. The shock-resistance of the body is combined with the hardness and strength of Kennametal to produce a tool for rapid face milling, side milling, end milling, slot milling, and straddle milling.

These milling cutters employing double negative rake angles are avail-



Grayson-Kennametal Milling Cutter

able in grade KM for milling steel, and with positive rake angles in grade K2s for rough milling of cast iron, or grade K4H for milling aluminum-silicon alloys, magnesium-aluminum alloys, brass, bronze, and most other non-ferrous metals.

A NEW type diamond dressing tool for thread grinding wheels was recently announced by Wheel Trueing Tool Company, Detroit, Mich. This tool utilizes the hard characteristics of the natural uncut diamond, yet it is of a shape that permits not only straight dressing, but angle, radial and multiple



Diamond Dressing Tools made by Wheel Trueing Tool Company

form dressing as well. It is said to produce exceptionally clean cuts, so that forms are obtained quicker and held longer. Another advantage of this diamond tool, according to factory officials, is that it can be made and serviced on a production basis, thus assuring quick deliveries.

WALES Type "B" Hole Punching Units with new adjustable adapters have just been brought out by the Wales-Strippit Corporation, North Tonawanda, N. Y. These adjustable adapters are for mounting Type "B" Hole Punching Units on press brake rails and provide staggered as well as

straight line hole punching patterns. Maximum front to back adjustment of these adapters is 3 in.

Wales Type "B" Hole Punching Units are designed for interchangeable use on press brake rails with adapters and T-slotted plates and templates in punch presses. Set-ups on T-slotted plates and templates are made by bolting these units directly to T-slotted plates and templates in exact position determined by master pattern.

Nothing is attached to the press ram, therefore it is possible to set the units in position and start operating. Punch, die, stripper assembly and guide are self-contained in holder which insures

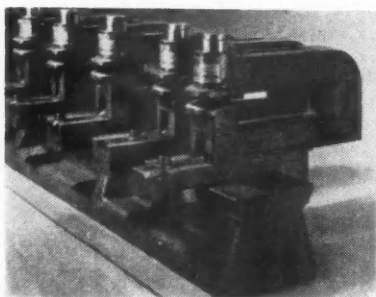
WE'D LIKE TO Emphasize Our Service!

BUILDING good springs, exactly to your specifications, is what we're expected to do. Furthermore it's what we have always done and will continue to do — to uphold our reputation for quality. But today, the feature we'd like to stress is Accurate Service. It's not the ordinary kind of service you would expect from an ordinary source of supply; that isn't good enough, — today! The service we mean is the kind that's based on the complete cooperation of everyone here . . . in the office . . . in the plant . . . and in the field; not the "take-it-or-leave-it", "best-we-can-do" kind. It's the kind of service that gets things done for you — so you can do your job better and faster — so that we may more quickly return to building things that make life better — not worse.

Accurate service is for you, if you need springs and wire forms. Write for our new Handbook of Technical Data on Springs. No obligation.

Accurate Springs

ACCURATE SPRING MANUFACTURING COMPANY
3811 W. Lake Street • Chicago, Illinois



Wales Type "B" Hole Punching Units with Adjustable Adapters

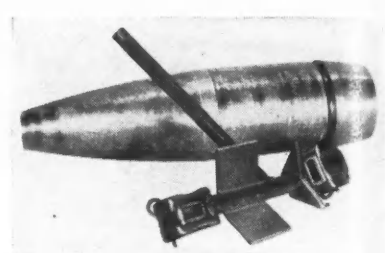
perfect punch and die alignment. Each unit is independently designed for quick

removal or replacement in patterns.

Wales Type "B" Hole Punching Units are also available with back stop gauge rods, 1 3/8 in. center-to-center hole minimum and in throat depths up to 18 in.

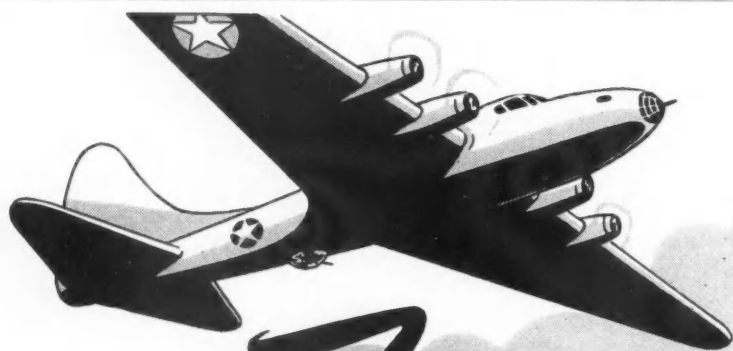
To meet shell manufacturer's requirements for a versatile shell marker, the M. E. Cunningham Co., Pittsburgh, Pa., has made available a Dual Purpose Box Type Holder which is said to successfully meet the specialized requirements.

The holder is of special design for stamping identification marks on end and side of semi-finished 155MM shell forgings in one operation. Guide



Dual Purpose Box Type Holder

plates level both type holders to assure clear, uniform markings. Spalling and mushrooming are eliminated by the use of safety steel.



Felt

HELPS BOMB THE SOURCE OF THE RUBBER IT REPLACES

● On all fronts fly planes with Western Felt products replacing parts that formerly required rubber. But there is special satisfaction in dropping bombs on the Jap rubber supply, with some assistance from felt. The flexibility, resiliency, compressibility, sound-deadening and water resistance of this material have resulted in its specification for hundreds of products.

Western is producing treated and special felts manufactured to a surprisingly close tolerance. Look over the list of materials required to your production, and let Western aid you in suggesting "felt as an alternate".



WESTERN FELT WORKS

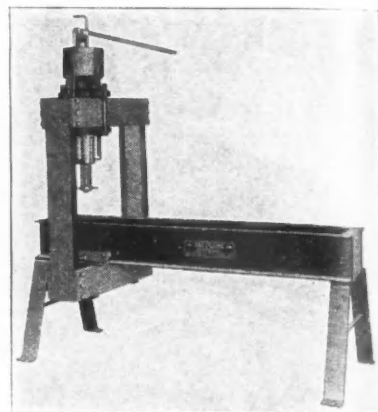
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WESTERN

Largest Independent Manufacturers and Cutters of Hair, Wool and Jute Felts

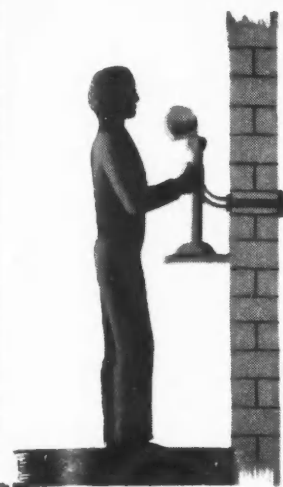
GROMMETS • CHANNELS • WASHERS • GASKETS • PADS • WICKS • INSULATION • ETC.

Felt



Modern 50-ton press manufactured by the Bee Line Company, Davenport, Iowa. The press as illustrated is available with an 84 in. or 96 in. bed. The press has 16 in. clearance between the end of the ram and top of the bed—ram travel 7 in., quick-acting screw in ram travels 7 in., making a total stroke of 14 in. obtainable.

Two new models of hydraulic flame hardening machines have been added to the line of Hydraulic Machinery, Inc., Detroit, Mich. The "Hy-Mac" bench model No. 501 flame hardening machine is designed for handling small parts. Different shapes and sizes may be hardened by revising the multiple duty holder and changing the tips on the burners. After the time cycle has elapsed, an automatic switch causes the solenoid to retract, allowing the part to drop into the quenching medium immediately under the fixture. The "Hy-Mac" floor model No. 502 flame hardening machine has a base of welded steel construction and is operated by a standard "Hy-Mac" Power Unit. It is fully automatic in operation and was designed for the hardening of sprockets. On the one side of the table is the indexing mechanism which holds the work and also has a lifting and lowering movement. On the other side is a moveable platform where are mounted two special water cooled torch tips and two quenching nozzles. With the part in place, the entire heat-quench operation is automatic. Initial machine movement, with sprocket in place on the indexing table, brings the table into position so that torches



THERE'S NO ESCAPING IT!

A rush order comes through from Washington
—the production manager is needed at once!

He's a half a mile away from his desk... but
you'll find him as fast as you can say his name...
thanks to Stromberg-Carlson Straight-line Communication.

It does the job **QUICKER** and **BETTER** than by any other means!

Think of the savings in critical manpower. Think of how it makes your telephone
system more effective... by not tying up limited lines.

It's the fastest way of giving instructions to prevent accidents... to help in
emergencies. It's the most efficient way of broadcasting warning signals...
fire alarms, air raid alerts, all clear.

Think it over, and remember... Stromberg-Carlson has been manufacturing
sound reproducing equipment of the highest reliability, the utmost durability
for nearly half a century.

Today our installations are helping speed production, promote safety in war plants
throughout the nation.



For these reasons, we believe we're specially fitted to solve your own
communication problem. Before you decide on any particular sound
system, get in touch with the Sound Systems Division of the Stromberg-Carlson
Company, 100 Carlson Road, Rochester, New York.

Write for free Booklet No. 1931



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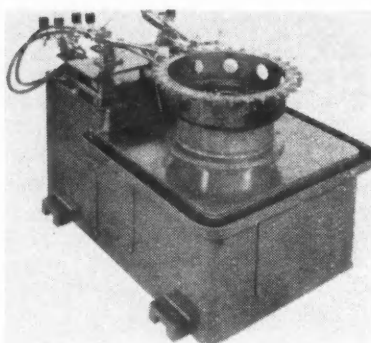


STRAIGHT-LINE COMMUNICATION SAVES MANPOWER • SPEEDS THE WORK TO VICTORY

August 1, 1943

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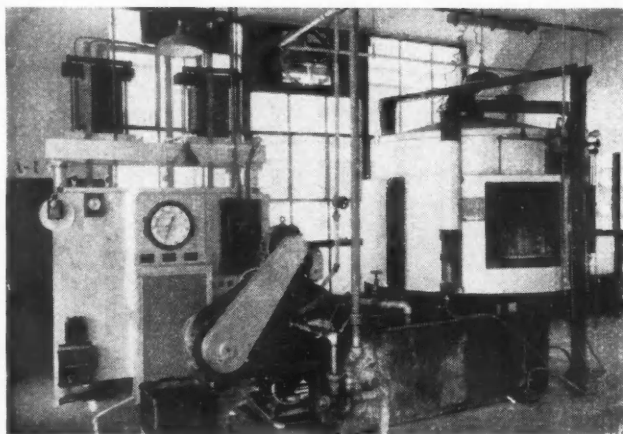
and quenching heads surround adjacent teeth. At the same time, the pilots ignite the torches which turn on by automatic operation of electric holding relays and solenoid valves in the supply lines of the torch heads. Water is turned on automatically at the quenching heads. Forward movement of the table engages a limit switch which starts an electric timer that determines the period of dwell to bring the teeth up to heat. At the end of the dwell period, the indexing table lowers the sprocket away from the torches and the quenching heads and turns to the next position. The cycle is repeated until all of the teeth are hardened.



Hy-Mac No. 502 Flame Hardening Machine

EF FURNACES

For Every Industrial Heat Treating Process



THESE SMALL EF SPECIAL ATMOSPHERE FURNACES HEAT TREAT 250 LBS. PER HOUR - - SCALE FREE

While more widely known as "designers and builders of large production furnaces," The Electric Furnace Co. also builds numerous types of smaller continuous automatic units. These smaller furnaces incorporate the same expert engineering service and experience and the same ruggedness and refinements which characterize our larger installations.

The above rotary, scale-free hardening furnace is an excellent example. This comparatively small and inexpensive installation handles miscellaneous small and medium sized products such as springs, bolts, screws, etc., at the rate of 250 lbs. per hour.

The complete unit consists of furnace, quenching equipment, automatic controls and an Elfurno generator for supplying the protective atmosphere for scale-free hardening.

With this equipment, the heat treating of miscellaneous small and medium sized parts and products is placed on a practical, continuous, uniform and economical basis. The furnace has two doors and two quench tanks. The material is loaded into heat resisting alloy

trays, carried around the furnace and discharged through sealed chutes to either a water or an oil quench. The drive is so arranged that the rotation of the hearth may be in either direction, thus by using opposite doors for loading, it is possible to operate the furnace in either direction and to discharge into either the oil or the water quench.

This permits considerable flexibility as the material may be either oil or water quenched from the same equipment without moving the quench tanks or changing the quenching medium. By removing the material from the trays instead of discharging into quench tanks, this furnace can also be used for drawing, annealing or other processes.

For heat treating from 300 to 1700 lbs. per hour, we recommend the EF Continuous Chain Belt Conveyor Type Furnaces which we build in five standard sizes. These furnaces handle all kinds of products ranging in size from small springs, bolts, and bearing parts up to large track links for tanks and tractors.

Send for additional information on the above and other types.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production

Thompson Aircraft

(Continued from page 25)

grinders replacing three conventional form-grinding operations formerly required.

Another activity is the constant search for machine methods to displace hand operations such as polishing, lapping, burring, etc. A battery of tumbling barrels has been installed to eliminate the many tedious hand operations of breaking corners, burring, polishing, etc. This has proved so successful in handling many small precision parts that the initial installation is being greatly expanded.

Perhaps of widest interest to those interested with economical metal cutting is the program for the utilization of cemented-carbide tools for steel cutting in the interest of increasing productivity and in getting the most out of the modern machine tools. To this end TAPCO has established a separate tool engineering department, operating on a 24-hour schedule. Shifts of tool engineers are constantly at work studying individual operations to establish standards of speeds and feeds and simplified tool forms. This program is so extensive that the company is drawing upon the resources of many of the cemented-carbide producers including Carboloy, Firth-Sterling, Vascoloy-Ramet, and McKenna, for tools as well as engineering advice. Cemented-carbide tooling is treated as a special project, has its own tool room, and its own tool grinding department.

Another example of current improvement is a change made in the method of loading nitriding furnaces, resulting in an increase of 50 per cent in capacity. Initially, this procedure had the effect of relieving a serious bottle-neck in production but later was instrumental in reducing by one-third the number of furnaces required for additional expansion.

The continuing program of improvement in production methods is assured by the establishment of a process development department. This is housed in a corner of the plant, removed from the hustle and bustle of production activity. Here the skilled craftsmen work on the initial development of tooling, special machine set-ups, etc., actually building and trying out improved arrangements so that each new project may be placed directly into production without further experimentation.

One activity in this plant, of particular interest to the writer, is the special attention that has been given to the utilization and management of cutting fluids. The TAPCO setup is well worth study on the part of other plant managers. Essentially, the program is one of assuring the absolute purity and cleanness of cutting fluids for precision operations, coupled with the conservation of these critical materials.

To this end, precision equipment such as thread grinders, plain and



HARDENED GEARS BROACHED

Rapidly and Economically

Heat treat distortion in hardened gears is corrected by broaching with RED RING Naloy Broaches. In fact, RED RING engineers have pioneered in this field.

Naloy is a very tough, hard alloy developed especially for broaches and form tools. It shows a useful service life 150-200 per cent longer than other steels usually used for broaches and it is particularly effective in tough forgings and castings.

Write RED RING engineers for special advice on broaching operations and send for the descriptive bulletin on Broaches.

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RED RING PRODUCTS

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**SPECIALISTS ON SPUR AND HELICAL
INVOLUTE GEAR PRACTICE**

**ORIGINATORS OF ROTARY SHAVING
AND ELLIPTOID TOOTH FORMS**

centerless grinders, are grouped in families and served by a self-contained filtering and circulating system for their cutting fluid. Here, for example, is a large battery of precision thread grinders in one department. These machines are all connected to a central circulating plant in which the thread grinding compound is filtered, centrifuged, and re-circulated. Similarly, groups of cylindrical grinders and centerless grinders are inter-connected by troughs leading to a settling tank, thence to filtering units, then to a storage tank for re-circulating to the grinders.

In other departments, groups of

turning and boring machines using sulfurized cutting fluids are similarly connected to a common unit which filters and re-circulates the cutting fluid. This procedure greatly simplifies the management of cutting fluids for the variety of metal cutting operations, assures fine surface finish, protects the machine operators, and results generally in the most economical utilization of these expendable materials.

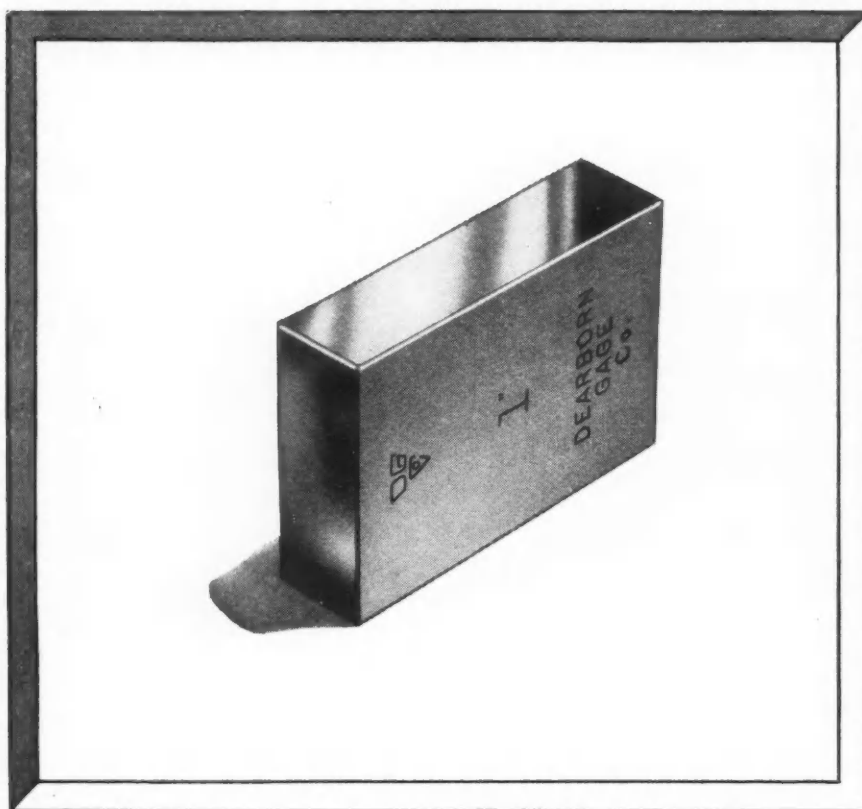
Finally, a few brief notes on the final inspection department. This consists of a large group of individual benches, each one provided with the necessary gages and instruments and special tools required for the type of

work handled on a particular bench. Here will be found a large variety of the well-known magnifying Sheffield shadow gages, J & L comparators of various types, Rockwell and Brinell hardness testers, Magnaflux inspection machines, etc. Generally speaking, the inspection department is completely outfitted to handle every variety of operations required to assure dimensional accuracy, perfection of surface quality, perfection of surface finish.

Ring Springs Used In Plane Shock Struts

When the first German JU88 bombers brought down more or less intact in England were dismantled for examination of the constructional details, it was found that cushioning effect in the telescopic legs of the undercarriage was provided by ring springs, a type of which were used in the buffers of German railroad coaches some years ago.

As the accompanying illustration indicates, this type of spring consists of two series of steel rings, one series double-coned or bevelled internally and the other correspondingly coned externally. Units of the two series are assembled alternately, one above the other, and are located axially in relation to one another by either an in-

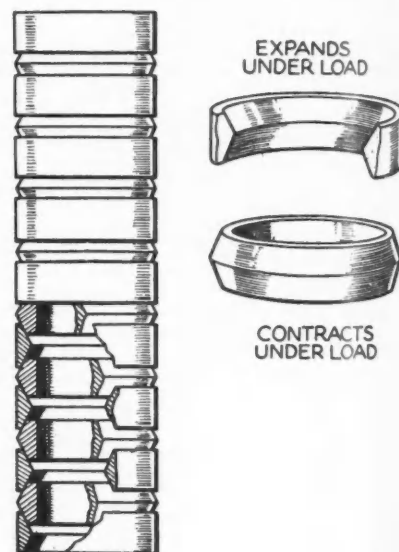


★
*A Picture
of
Accuracy*
★



DEARBORN GAGE CO. 22037 BEECH STREET
DETROIT, MICHIGAN

Originators of Chromium Plated Gage Blocks



ternal or an external telescopic tube, not shown. Or there may be two tubes, one external and the other internal.

In action the rings expand or contract circumferentially under load applied to the ends of the assembly. Owing to the angle of the conical mating surfaces of adjacent rings, there is considerable absorption of energy. It is stated that the input energy absorbed may amount to 70 per cent. The load capacity is equivalent to that of a helically wound spring of about the same weight. Fully enclosed and lubricated, this type of spring is said to have a resilience not much inferior to that of a clean and lubricated laminated spring.

More Thornton FOR ALASKA

FOUR-
REAR-
WHEEL

Drives

WILL HANDLE
VITAL TRAFFIC OVER
AMERICA'S BURMA ROAD



THORNTON
Four-Rear-
Wheel DRIVE
unit which
doubles original
truck capacity
and provides
tremendous
tractive ability.



AMERICA'S eyes are concentrated on the North Pacific. A vital supply line is the traffic-laden Alcan Highway, opened last season.

Proven by brilliant performance during the construction of the road were hundreds of trucks equipped with THORNTON Four-rear-wheel DRIVES.

This fine service record has re-

sulted in more than 750 additional trucks being put into service, this season, to do another spectacular job on America's road to Tokyo.

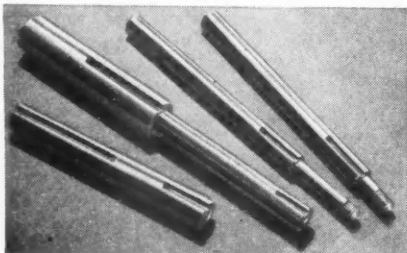
By means of THORNTON equipment, the original capacity of these dump-body trucks has been raised from $2\frac{1}{2}$ to 4 yards. The tractive ability, with two driving axles under the load instead of one, has been immeasurably increased.

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PRECISION PARTS

4 MORE ACES UP UNCLE SAM'S SLEEVE

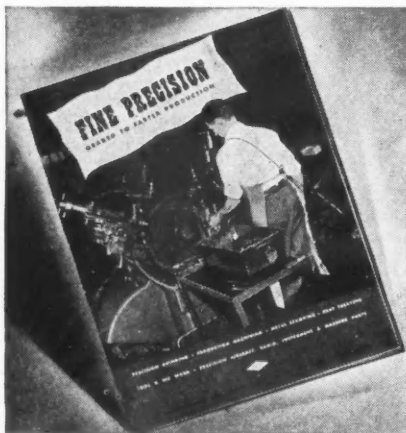


*Precision-machined, precision-ground
on all diameters and threads.*

Elevating shafts . . . vertical training shafts . . . screw leveling shafts . . . just so many metal parts to the uninitiated. To the Jap pilot in a Zero, however, they mean anti-aircraft fire too accurate for comfort.

These vital parts of an anti-aircraft gun are typical of the ability of Ace to do fine precision-work on a mass-production basis. The ground tolerances are .0003" (1/30 the thickness of a human hair) . . . key-ways are held within .0004" and must be absolutely parallel from end to end and side to side . . . concentricity between diameters is held to less than .0005" . . . and threads must be ground for the fine accuracy so essential to final assembly and quick replacement.

Today, the demand is for speed, and Ace offers its facilities to other manufacturers on a 24-hour-a-day, 7-day-a-week production basis, embracing: 1. The finest machines in the industry. 2. Managerial know-how for producing parts twice as fine, ten times as fast, as ever before. If you have small parts for stamping, machining, grinding, or assembling, send us a sample, a sketch, or a blue-print for quotation.



This new booklet describes the facilities available at Ace for the machining, assembling and heat treating of small parts. A copy will be gladly sent upon request.



**ACE
MANUFACTURING
CORPORATION**

for Precision Parts

1241 E. ERIE AVE., PHILADELPHIA 24, PA.

Borings and Turnings

(Continued from page 18)

and positive identification of nickel alloy steels has been placed on the market. This spot test procedure was developed for the purpose of sorting gear stock which had become mixed. Similar spot test methods for the detection of molybdenum, chromium, tungsten and manganese are available, though not in kit form.

Closely affiliated with the task of conserving and segregating scrap, is that of preventing, wherever possible, unnecessary additions. Tool-tipping can keep thousands of tons of valuable alloy steels from the scrap pile. Wright Aeronautical Corp. has impressively increased the useful life of the alloy steel in lathe tools by using a new form of chip breaker groove and finely finishing the cutting faces of tools used in the machining of alloy steel forgings.

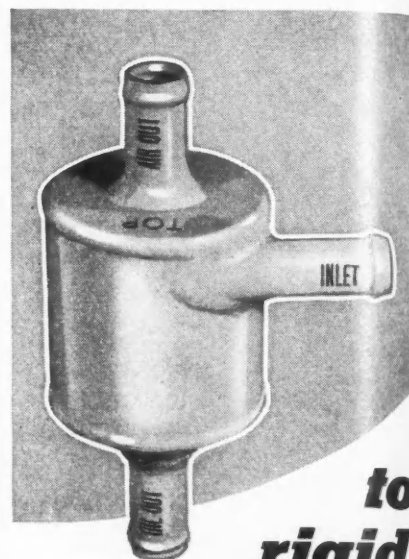
Although war material specifications brought to the scrap salvaging departments of automotive plants some changes in the classes of scrap they have to handle, the groundwork for efficient methods of conservation and segregation had been laid so well in the years of peacetime mass automobile production that no new problems came up to plague technical and supervisory staffs, all having been alloy as well as scrap-minded for years.

One of the interesting developments in recent days has been the appearance in the non-ferrous scrap market of parts of wrecked aircraft, presumably from planes that met with mishaps at home. Whether worthwhile quantities of scrap will come from battle-battered planes, that served on foreign fronts, only the future will reveal. But that aviation scrap will eventually take its place by the side of automobile scrap in the secondary metal market is certain.

British Postwar Planes

In the House of Commons, Deputy Prime Minister Attlee announced that orders had been placed for designs and prototypes of four types of transport machines, provided that war production had priority. It has since been revealed that five British aircraft manufacturers are concerned, i. e., the Bristol Aeroplane Co., A. V. Roe and Co., Handley Page and Short Brothers co-operating with Saunders-Roe.

A. V. Roe is already building the Avro-York transport version of the Lancaster heavy bomber; some examples, in fact, are even now flying. Of the four types to be built three are landplanes, but the joint venture of Short Brothers and Saunders-Roe will be a flying boat, which will have a range of 4000 miles carrying 23 long tons of gasoline and will be capable of carrying up to 220 passengers on a "short" journey, such as that from Britain to the Mediterranean; the all-up weight will be 70 long tons. No details of the landplanes have been released yet.



**to
rigid
standards**

MERCURY served a twenty year apprenticeship for war... designing, perfecting and building equipment for the Army and Navy... tooling, equipping and training personnel to produce many essential products against the day of boundless need.

for instance . . .

take oil separators for the vacuum pump in de-icing equipment. For years, we have supplied these small but vital parts to Army and Navy. Today, most builders of military airplanes in this country and in Canada call on us for these essential devices.

At the Cradle of Aviation





HE'S CALLED "MIRACLE MAN"

SMOKE from stacks in a score of great plants etch his name against the industrial sky. He's a production wizard who refuses to tolerate the word "impossible." But he'll admit proudly that his achievements are the result of organizing and coordinating the talents of others.

In one of his plants, for instance, the chances are you would find parts, assemblies and machines of precision workmanship by Joyce, writing new records in speed and precision. For

another plant, Joyce may be producing and assembling vital and integral parts of these weapons of war—parts where hairline precision can mean the difference between success or failure.

Joyce designing and engineering skill is helping to achieve production miracles in many great industrial plants from coast to coast. And Joyce's own large-scale production facilities are maintaining a steady stream of war material for our fighting forces—covering a wide and constantly varying

range of machined and fabricated parts and products.

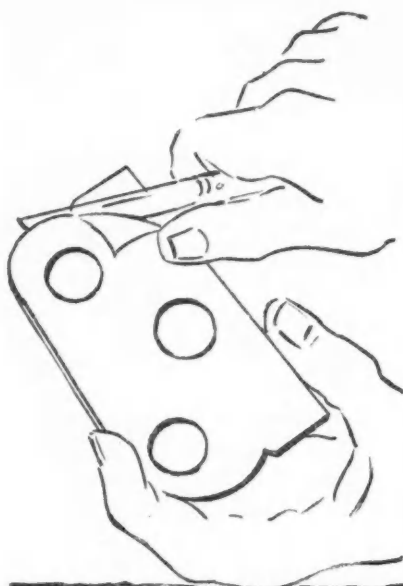
If you face production problems in your business—either for war work or post-war production—the Joyce "know how" is at your service. A Joyce representative will be glad to call and explain in detail the unique advantages we offer.

BEHIND THE MAN ♦ BEHIND THE MAN ♦ BEHIND THE GUN

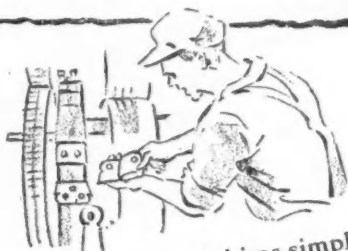
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LAMINUM shims simply peel for precision adjustment, right at the job... release men and machines from old-fashioned shim-fitting, for more productive work.

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2042

Domestic Industries Buys Siewek Tool Co.

Domestic Industries, Inc., Chicago, has recently purchased the 33-year old Siewek Tool Company of Ferndale, Mich. Two affiliated companies, Siewek Tool & Engineering Co., Hartford, Conn., and Progressive Tool & Cutter Co., Ferndale, Michigan, were included in the acquisition.

Chrysler Engines

(Continued from page 42)

the features is quick starting in the coldest weather. Cold-room tests in the Chrysler Engineering Laboratories have shown their ability to start without delay in a temperature as low as minus 40 F. General specifications of the two engines are as follows:

M-12 Marine Engine

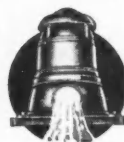
General—Six cylinders cast en bloc integral with crankcase, overhead type valves; Cylinders—Alloy Iron; Cylinder Head—Alloy iron with hardened steel exhaust valve seats, fuel injection nozzles and the energy cells; Crankshaft—Steel, Tocco hardened, statically and dynamically balanced. Equipped with a torsion damper and drilled for forced feed lubrication; Main Bearings—Seven tri-metal replaceable precision type main bearings; Pistons—Alloy pistons tin-plated with 2 oil rings, and 3 compression rings, made from electric furnace iron tinplated; Connecting Rods—I-beam section, alloy steel. Trimetal replaceable precision type bearings; Valves—Alloy steel; Camshaft—Drop forged steel with forced feed lubrication. Six bearings all replaceable except No. 6 which is part of block; Oil Pump—Gear type, Oil pump suction screen—Floto type; Lubrication—Pressure feed to all crankshaft and camshaft bearings, reverse gear and reduction gear; Oil Cooler—Bronze tubular type; Oil Filter—Removable cartridge type; Cooling System—Fresh water with Harrison type heat exchanger. Centrifugal pump for circulating fresh water and rubber covered gear type pump for sea water. Thermostat control for fresh water; Fuel System—Excello. Injection pump, governor and transfer pump one unit. Six nozzles, one for each cylinder. One single filter between fuel tank and transfer pump and other between the transfer pump and the injection pump. Air intake heater and time switch; Electrical System—24-volt. Generator with automotive voltage and current regulator, starting motor; Reverse Gear—Planetary type. The ahead clutch is of the disc type with bronze and steel plates. Inspection plate on reverse gear case for ahead adjustment. Reverse by means of fabricated band contracting on clutch drum. Adjustment on outside of case with automatic take-up; Reduction Gear—Chrysler internal gear and pinion type with helical teeth. Gears, alloy steel shaved and hardened, mounted on a large ball bearing. Available with either 1.43; 2.03; 2.51; 3.17; 4.48 or 9 to 1 reduction.

Ind-3 Industrial Engine

General—Six cylinders, alloy iron, cast en bloc integral with crankcase, overhead type valves; Cylinder Head—Alloy iron with hardened steel exhaust valve seat inserts, fuel injection nozzles and energy cells; Crankshaft—Drop forged steel, tocco hardened, statically and dynamically balanced. Equipped with a torsion damper and drilled for pressure lubrication; Main Bearings—Seven tri-metal replaceable precision type main bearings; Pistons—Alloy



TIME IS EVER FLOWING FASTER



"The duration"—which not so long ago seemed to be unpredictable, is now visualized over not so many tomorrows. Close upon the heels of Peace will come urgent new calls for greater industrial activity. The fields of expanding commerce will extend far beyond the Continental United States. American business men will send their wares to, and establish their plants in many foreign lands.

It will be an age of quality, efficiency and speed! It will be an age in which Layne, with more than sixty years of outstanding success will enjoy even greater achievements. Innovations, discoveries and improvements made by Layne for Military and Naval use will speed the installation of wells. Pumps of greater capacity and higher efficiency will be in production. New hydrological engineering developments will be made available for all manner of industrial, commercial and agricultural use. Layne will brilliantly maintain the position of world leadership in the well water development field.

Layne Pumps and Well Water Systems have long been miles ahead of competition. They are basically sound and proven in quality. They embody the most advanced engineering features. They are sturdy in construction, unequalled in efficiency and outstanding in reliability.

For fully illustrated literature, address LAYNE & BOWLER, INC. General Offices, Memphis 8, Tennessee.

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For **FASTER, BETTER
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Learn the advantage to you in obtaining faster, better finishes on rods, tubes, bars and a wide variety of cylindrical shapes. View above shows finishing operation on 1-7/16" diameter x 4150 hot rolled bar. Inset is standard Hammond unit engineered to operate with either grinding, polishing or buffing wheels, or contact wheel with abrasive belts running to backstand-idler.

USE EITHER WHEELS
OR ABRASIVE BELTS

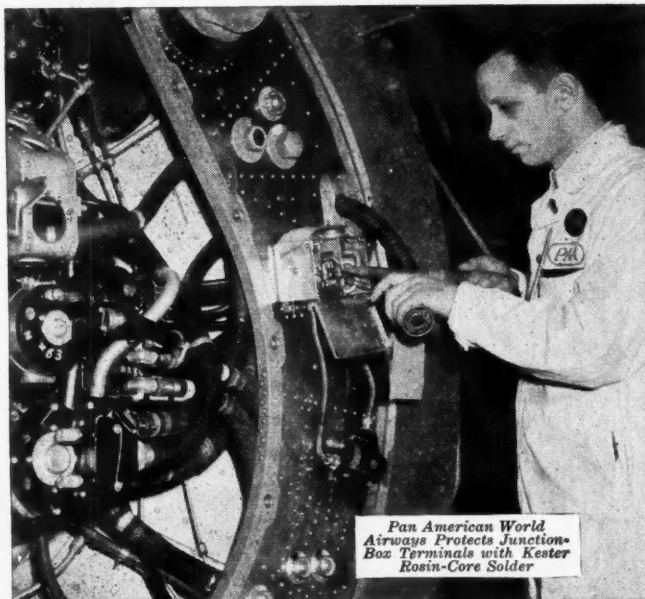
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● In general use, Kester Acid-Core Solder makes a tight, clean, permanent union. Like all Kester Cored Solders, it expedites production. Both flux and solder are applied in one sure, simple operation.

● All Kester Cored Solders hold tight! They stand up under bending, shock, vibration, and the contraction and expansion of temperature extremes from the Arctic to the Tropics.

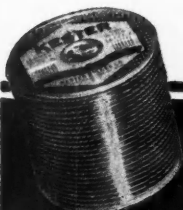
● Kester engineers will gladly assist you in selecting the proper combination of alloy, flux and strand- and core-size to fit exactly any soldering requirement in your production. Consult them freely, without obligation.

KESTER SOLDER COMPANY

4202 Wrightwood Avenue, Chicago, Illinois

Eastern Plant: Newark, N. J.

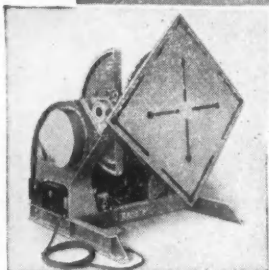
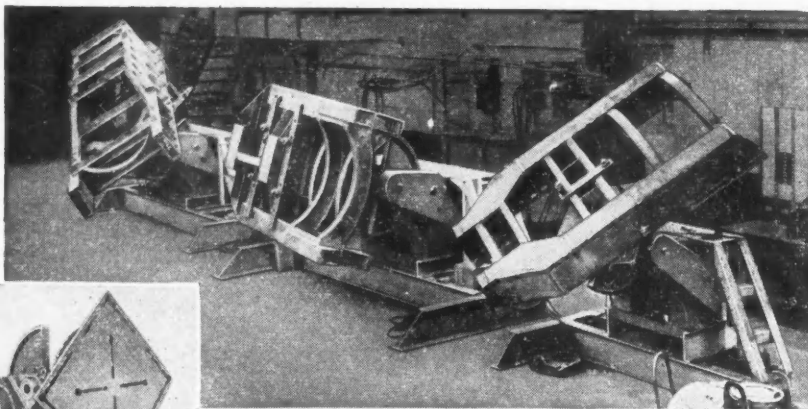
Canadian Plant: Brantford, Ont.



SILVER-LEAD ALLOY—Kester is prepared to offer for test on your work, a wartime solder of silver and lead, in cored and wired form.



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STANDARD FOR INDUSTRY



6,000-lb. capacity unit.

In handling the cumbersome frame assemblies illustrated, the welders can swing them through 360° and tilt them as far as 135° beyond horizontal. Both men and women welders like Ransome equipment because it steps up their production and reduces fatigue.

POSITIONING PERMITS YOUR WELDERS TO CONCENTRATE ON WELDING...

It's certainly not good business to waste welders' time and energy in "rasseling" the work around... not when a Ransome Positioner will do the job at the touch of a switch.

This equipment improves quality by providing the correct downhand position for every weld, saves valuable floor space, promotes safety, and speeds up welding production generally.

There's a type and size for *your* welding needs... in a line that extends from light-duty hand-operated up to 40,000-lb. capacity. » Write for full information.

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SELF-LOCKING ANCHOR NUT



Camloc engineering and testing facilities available for your fastener problems. Catalogue on request.

Adequate production facilities now assure prompt delivery of the new Camloc Self-Locking Anchor Nut No. 366. Fully approved by the U. S. Army Air Corps. Gives absolute tightness to fastenings under vibration and critical stresses. Two flat sides afford maximum space for riveting. Saves 35% in weight. Initial production in sizes -F1032 and -F832.

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pistons, tin-plated with 2 oil rings and 3 compression rings made from electric furnace iron, tin-plated; Connecting Rods—Drop forged, I-beam section, alloy steel. Tri-metal replaceable precision type bearings; Valves—Alloy steel; Camshaft—Drop forged steel with pressure lubrication. Gear driven on six bearings all replaceable except No. 6 which is part of block; Oil Pump—Gear type. Oil pump suction screen—Floto type; Lubrication—Pressure feed to all crankshaft and camshaft bearings; Oil Filter—Heavy duty removable cartridge type; Air Cleaner—Oil Bath large capacity industrial type; Accessories—Numerous accessory safety devices for engine protection available when requested. Various commercial clutches and power take-off stub shafts available on Standard S.A.E. housings; Cooling System—Industrial type radiator with thermostat in the water outlet from engine; Fuel System—Ex-Cell-O fuel pump and nozzles, injection pump, governor and transfer pump one unit. First filter between fuel tank and transfer pump with second filter between the transfer pump and the injection pump. Air intake heater and time switch for cold starting; Electrical System—24-volt Generator with automotive voltage and current regulator, starting motor; Governor—Integral with Ex-Cell-O fuel pump, sensitive, closely regulated.

Convair Flying Boat

(Continued from page 27)

protects the gunner in this section.

Model 31 originally was fitted with a tricycle beaching gear which was retracted into the hull during flight. To cut down weight, this system was abandoned in favor of beaching gear which is held at the operating base. This beaching gear is novel to the extent that it is unnecessary for groundmen in charge of the beaching gear to wade. The main double-wheeled gear is floated to the airplane, attached to the hull and set in position. The gear is then submerged into position by a hydraulic jack and locked from within the hull. The bow gear is forced into

Consolidated Vultee Model 31 Data

Army designation.	None
Navy designation.	P4Y-1
Manufacturer's designation	Model 31
Engines	2 Wright R-3350, 2000 hp.
Gross weight	46,000 lb. (Overload 48,000 lbs.)
Number of crew or passengers, or both	Seven
Cruising speed	Over 160 mph.

position with a long handle and fastened within the hull. Wheels are swivelling through the use of the built-in jack.

When the plane goes into production in New Orleans, one item of equipment will be the new thermal anti-icer, perfected on this and other models produced by Consolidated Vultee under the supervision of the National Advisory Committee for Aeronautics. This system, using a series of heat exchangers in the motor exhaust ducts, permits operation in outside temperatures as low as minus 40 F with temperatures of wing and tail surfaces remaining well above freezing. It also supplies heated air between the double panes of the pilot's and co-pilot's window for defrosting and heats the plane through the use of various pull-offs located at stations in the flight deck.